ICT CONCEPTS

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Information and Communication Technologies (ICT)

Information and Communication Technologies (ICTs) is a broader term for Information Technology (IT), which refers to all communication technologies, including the internet, wireless networks, cell phones, computers, software, middleware, video-conferencing, social networking, and other media applications and services enabling users to access, retrieve, store, transmit, and manipulate information in a digital form.

Information and Communication Technology

Data, Information and Knowledge

❖ **Data:**

Data is raw, unorganized numbers, signals, or facts. Without first organizing or changing it, humans struggle to use data. For example, your university might have data on the names, surnames, addresses, contact details, as well as the results of every class test, assignment, test and exam of all current and past pupils stored on a computer somewhere. While this data is important to store, it could be hundreds, or even thousands of pages long and very difficult to interpret!

Example

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

These are meaningless sets of data. They could be the first four answers in the 3 x table, a list of household pets and the heights of 15-year-old students but without a context we don't know.

Data, Information and Knowledge Cont'd

Data vs. Datum

Data are individual facts that are out of context, have no meaning, and are difficult to understand. They are often referred to as raw data. The term *data* is plural, equivalent to *facts*, while *datum* is singular, equivalent to *a fact*. Although some people continue to use the term *data* as singular, a comprehensive, denotative definition of *data* in the singular form, beginning with *Data is* ... is not available. Most definitions of data in the singular are really definitions of a data resource

Data, Information and Knowledge Cont'd

Data in Context vs. Information

Data in context are individual facts that have meaning and can be readily understood. They are the raw facts wrapped with meaning, but they are not yet information. *Datum in context* is a single fact wrapped with meaning.

Information is a set of data in context with relevance to one or more people at a point in time or for a period of time. Information is more than data in context – it must have relevance and a time frame. Information is considered to be singular.

Data, Information and Knowledge - Cont'd

❖ Information:

Information, in contrast to data, refers to facts and numbers that have been organized so that they are useful to people. For example, if your teacher wanted to see how well your current class is performing compared to last year's class, he/she might ask your school's database to convert its data into averages for the two years. In this way, those thousands of pages of data will be converted into two numbers that can be compared easily. Similarly, the report you receive at the end of each year takes all the data that the teachers collected throughout the year and turns that data into a single report that you can use to measure your performance.

If we put Information into an equation it would look like this:

Data + Meaning = Information

Data, Information and Knowledge - Cont'd

- **Information:**

Example

Looking at the examples given for data:

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

Only when we assign a context or meaning does the data become **information**. It all becomes meaningful when we are told:

- 3, 6, 9 and 12 are the first four answers in the 3 x table
- cat, dog, gerbil, rabbit, cockatoo is a list of household pets
- 161.2, 175.3, 166.4, 164.7, 169.3 are the heights of 15-year-old students.

Data, Information and Knowledge - Cont'd

❖ Knowledge

When someone memorizes information this is often referred to as 'rote-learning' or 'learning by heart'. We can then say that they have acquired some knowledge. Another form of knowledge is produced as a result of understanding information that has been given to us, and using that information to gain knowledge of how to solve problems.

If we put Knowledge into an equation it would look like this:

Information + application or use = Knowledge

Knowledge can therefore be:

i. Acquiring and remembering a set of facts, or

ii. The use of information to solve problems.

Data, Information and Knowledge - Cont'd

❖ Knowledge

i. The first type is often called explicit knowledge. This is knowledge that can be easily passed on to others. Most forms of explicit knowledge can be stored in certain media. The information contained in encyclopedias and textbooks are good examples of explicit knowledge.

ii. The second type is called tacit knowledge. It is the kind of knowledge that is difficult to pass on to another person just by writing it down. For example, saying that Paris is the capital of France is explicit knowledge that can be written down, passed on, and understood by someone else. However, the ability to speak a foreign language, bake bread, program a computer or use complicated machinery requires additional pieces of knowledge (such as that gained through experience) that are not always known explicitly and are difficult to pass on to other users.

Data, Information and Knowledge - Cont'd

Example

Looking at the examples given for **data**:

- 3, 6, 9, 12
- cat, dog, gerbil, rabbit, cockatoo
- 161.2, 175.3, 166.4, 164.7, 169.3

Only when we assign a context or meaning does the data become **information**. It all becomes meaningful when we are told:

- 3, 6, 9 and 12 are the first four answers in the 3 x table
- cat, dog, gerbil, rabbit, cockatoo is a list of household pets
- 161.2, 175.3, 166.4, 164.7, 169.3 are the heights of the five tallest 15-year-old students in a class.

If we now apply this information to gain further **knowledge** we could say that:

- 4, 8, 12 and 16 are the first four answers in the 4 x table (because the 3 x table starts at three and goes up in threes the 4 x table must start at four and go up in fours)
- The tallest student is 175.3cm.
- A lion is not a household pet as it is not in the list and it lives in the wild.

Misconceptions About Information

Some people have **misperceptions of information**. One misperception is that **information** is the **same as data in context**. Whenever raw data are wrapped with meaning, those data become information. However, if information is considered to be data in context, then the question becomes what are the terms for information that is relevant and timely and information that is not relevant and timely?

The answer might lead to **relevant information and non-relevant information**. However, only **relevant information leads to knowledge and non-relevant information does not lead to knowledge**. Therefore, raw data are wrapped with meaning to become data in context, which can become either relevant or non-relevant information. **Only relevant information can become knowledge.**

Misconceptions About Information – Cont'd

Another misperception is that information is any summary data or derived data. That misperception is not valid because whether data are primitive or derived, they are still data. They have not yet become relevant or timely and, therefore, are not yet information.

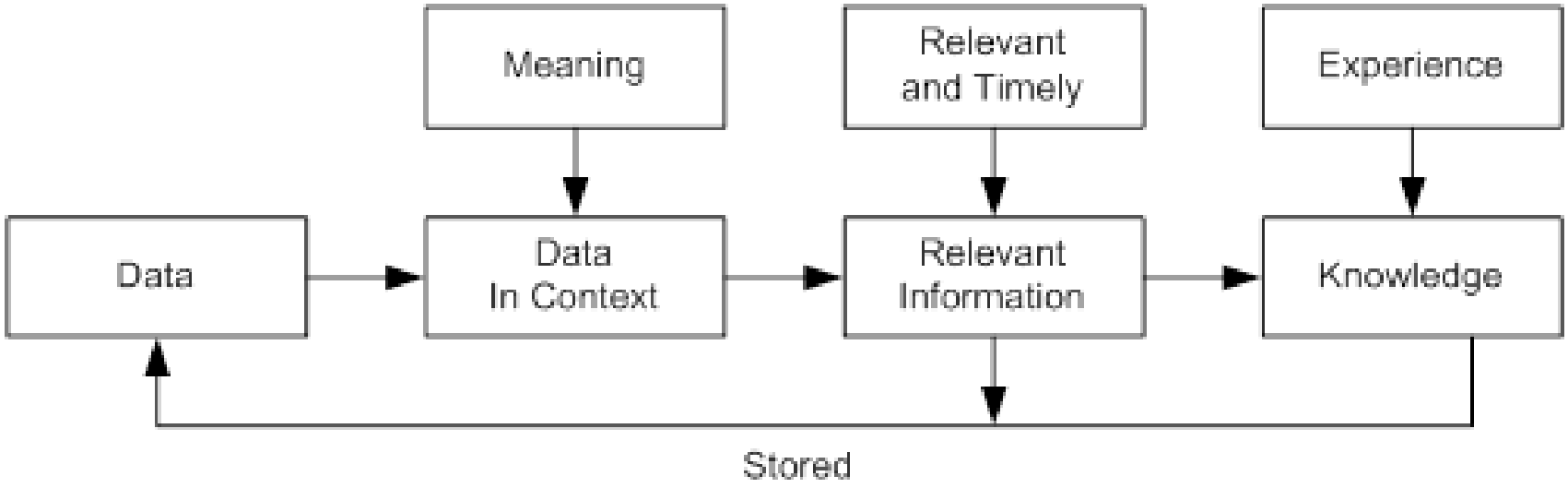
If data in context are not relevant or timely, then they are not information. However, data may not be relevant or timely to one person but could be relevant and timely to another person. Therefore, the definition of information can be expanded.

Misconceptions About Information – Cont'd

- *Specific information* is a set of data in context that is relevant and timely to one or more people at a point in time or for a period of time.

- *General information* is a set of data in context that could be relevant to one or more people at a point in time or for a period of time

Data-Information-Knowledge Cycle



The Importance of the Data-Information-Knowledge Cycle

Data Management professionals must establish proper terms that are comprehensively and denotatively defined and must use them properly. The development and proper use of basic terms such as the ones in the data-information-knowledge cycle is one step toward resolving the lexical challenge in data resource management and creating a formal Data Management profession.

Data Processing Cycle

The data processing cycle is the set of operations used to transform data into useful information. The intent of this processing is to create actionable information that can be used to enhance a business. This cycle involves the following steps:

- Collection of data
- Preparation of the data into a format suitable for data entry, as well as error checking
- Entry of the data into the system, which may involve manual data entry, scanning, machine encoding, and so forth
- Processing of the data with computer programs
- Transmitting the resulting information to the user, typically via screen or printed report, so that it can be acted upon
- Storing the input data and output information for future use

Data Processing Cycle – Cont'd

❖ **Stages of data processing:**

i. **Input** – The raw data after collection needs to be fed in the cycle for processing. This is considered the first step and called input.

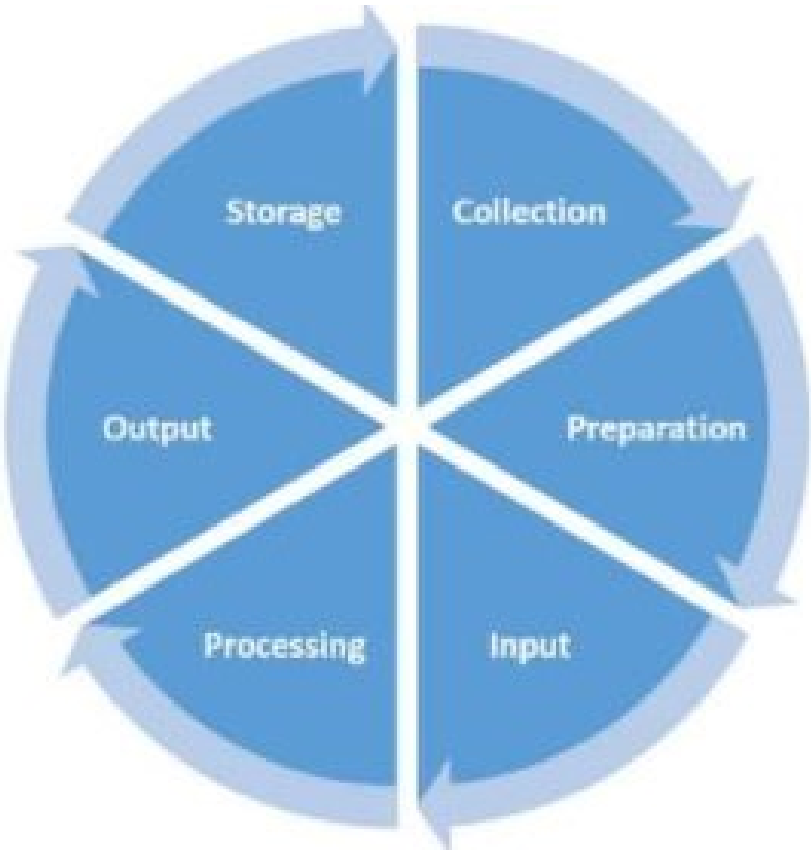
ii. **Processing** – Once the input is provided the raw data is processed by a suitable or selected processing method. This is the most important step as it provides the processed data in the form of output which will be used further.

iii. **Output** – This is the outcome and the raw data provided in the first stage is now "processed" and the data is useful and provides information and no longer called data.

Data Processing Cycle – Cont'd

Generally, there are six main steps in the data processing cycle:

- **Step 1: Collection**
- **Step 2: Preparation**
- **Step 3: Input**
- **Step 4: Data Processing**
- **Step 5: Output**
- **Step 6: Storage**



Data Processing Cycle – Cont'd

Step-1 Collection

The collection of raw data is the first step of the data processing cycle. The type of raw data collected has a huge impact on the output produced. Hence, raw data should be gathered from defined and accurate sources so that the subsequent findings are valid and usable. Raw data can include monetary figures, website cookies, profit/loss statements of a company, user behavior, etc.

Data Processing Cycle – Cont'd

Step-2 Preparation

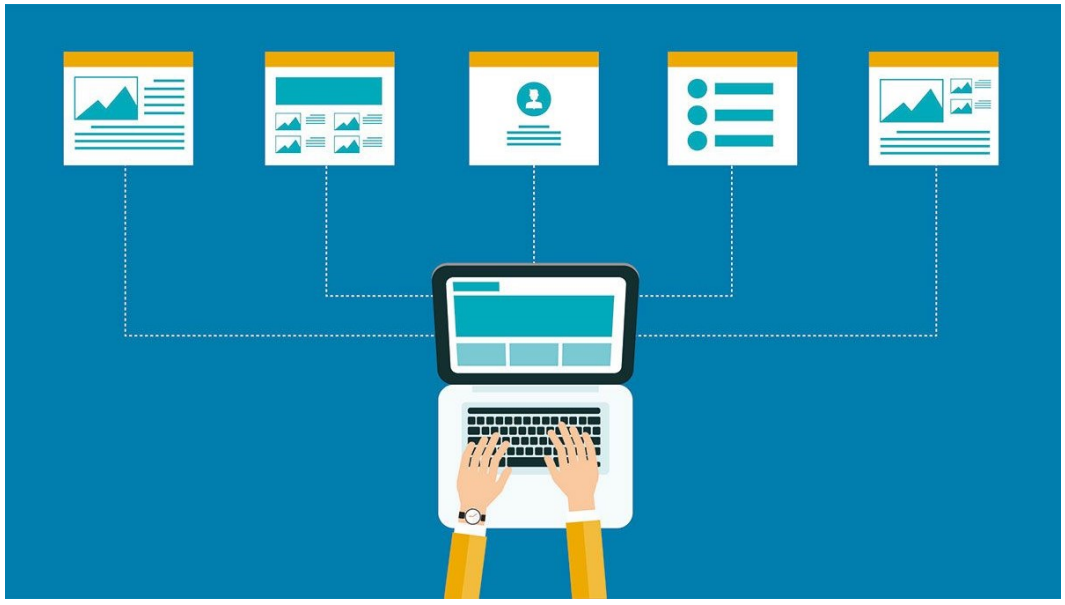
Data preparation or data cleaning is the process of sorting and filtering the raw data to remove unnecessary and inaccurate data. Raw data is checked for errors, duplication, miscalculations or missing data, and transformed into a suitable form for further analysis and processing. This is done to ensure that only the highest quality data is fed into the processing unit.

The purpose of this step to remove bad data (redundant, incomplete, or incorrect data) so as to begin assembling high-quality information so that it can be used in the best possible way for knowledge intelligence.

Data Processing Cycle – Cont'd

Step-3 Input

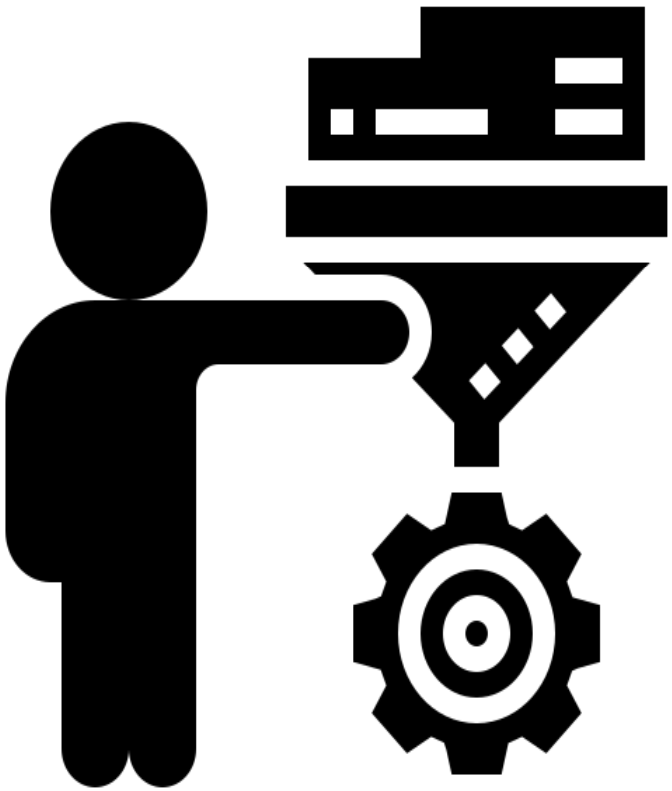
In this step, the raw data is converted into machine readable form and fed into the processing unit. This can be in the form of data entry through a keyboard, scanner or any other input source.



Data Processing Cycle – Cont'd

Step-4 Data Processing

In this step, the raw data is subjected to various data processing methods using machine learning and artificial intelligence algorithms to generate a desirable output. This step may vary slightly from process to process depending on the source of data being processed (data lakes, online databases, connected devices, etc.) and the intended use of the output.



Data Processing Cycle – Cont'd

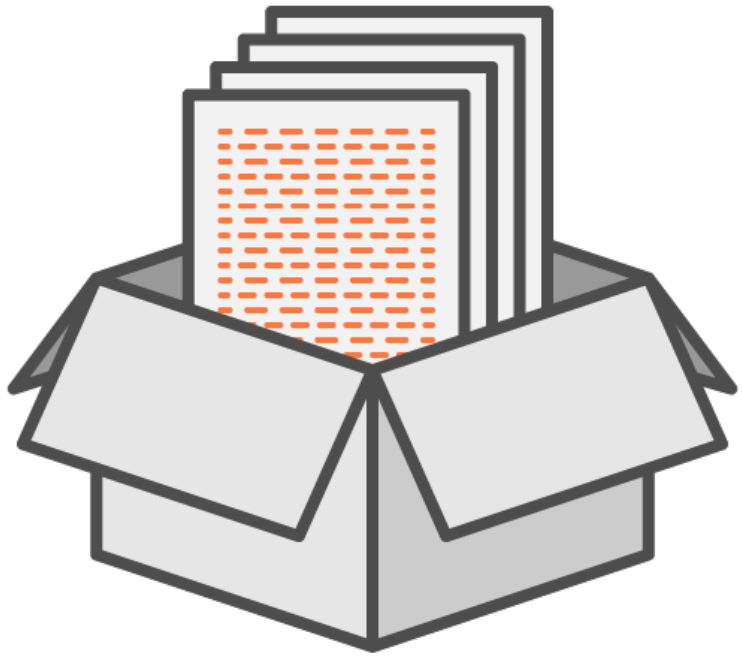
Step-5 Output

The data is finally transmitted and displayed to the user in a readable form like graphs, tables, vector files, audio, video, documents, etc. This output can be stored and further processed in the next data processing cycle..

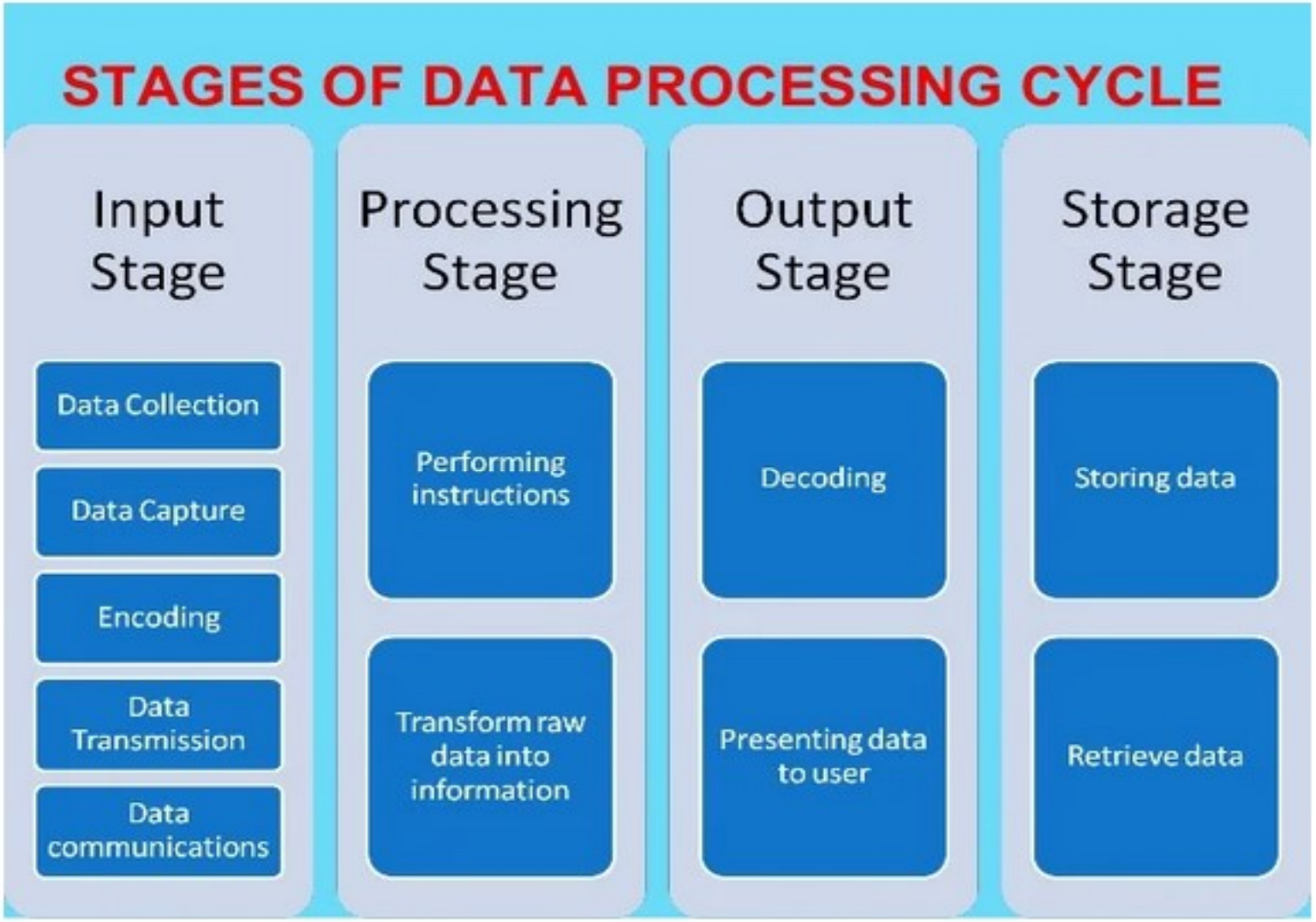
Data Processing Cycle – Cont'd

Step-6 Storage

The last step of the data processing cycle is storage, where data and metadata are stored for further use. This allows for quick access and retrieval of information whenever needed, and also allows it to be used as input in the next data processing cycle directly.



Data Processing Cycle – Cont'd



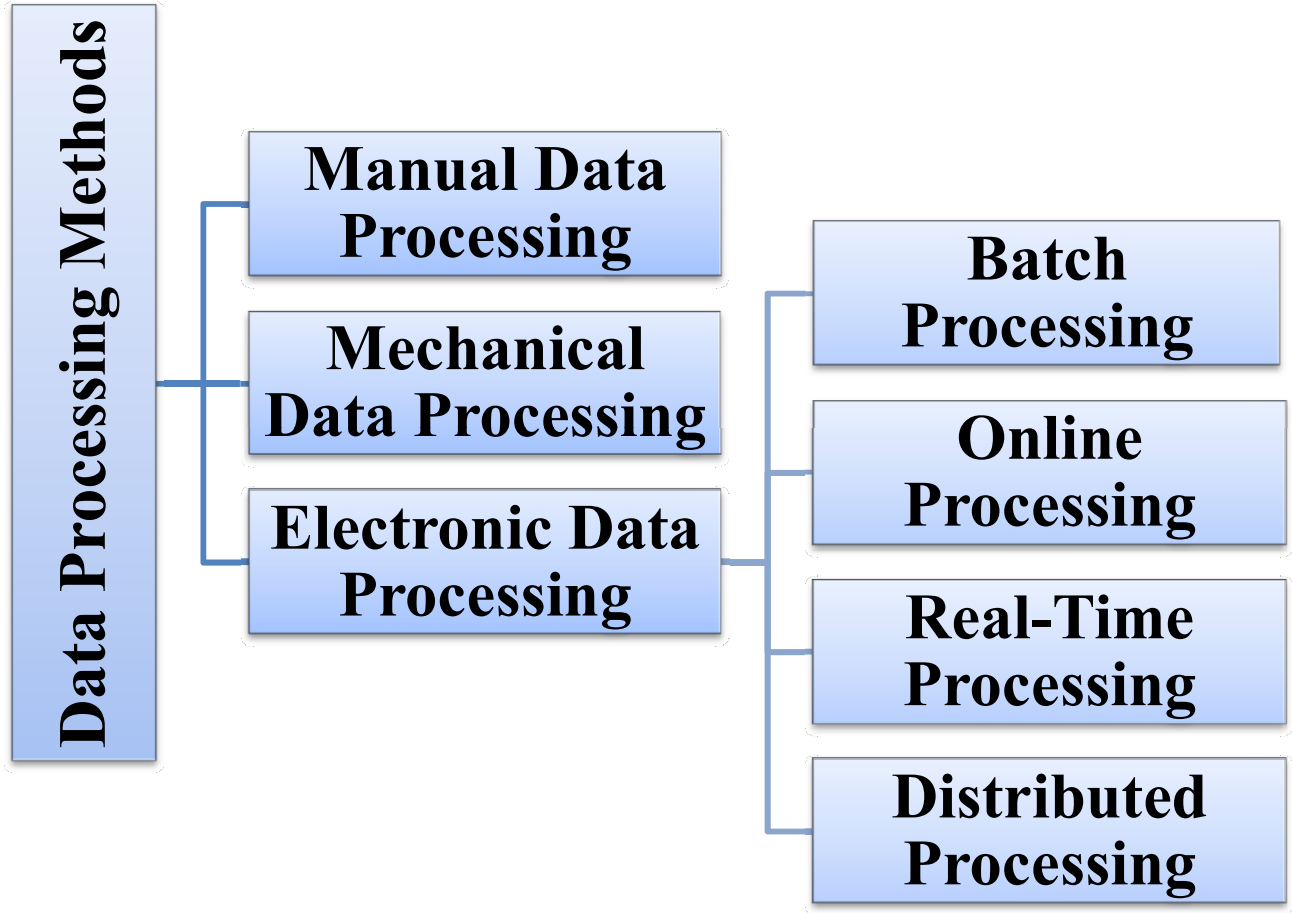
What is Data Processing: Types of Data Processing

Type	Uses
Batch Processing	Data is collected and processed in batches. Used for large amounts of data. Eg: payroll system
Real-time Processing	Data is processed within seconds when the input is given. Used for small amounts of data. Eg: withdrawing money from ATM
Online Processing	Data is automatically fed into the CPU as soon as it becomes available. Used for continuous processing of data. Eg: barcode scanning

What is Data Processing: Types of Data Processing – Cont'd

Type	Uses
Multiprocessing	Data is broken down into frames and processed using two or more CPUs within a single computer system. Also known as parallel processing. Eg: weather forecasting
Time-sharing	Allocates computer resources and data in time slots to several users simultaneously.

Data Processing Methods



Data Processing Methods – Cont'd

1. Manual Data Processing

In ***manual data processing***, data is processed manually without using any machine or tool to get required results. In manual data processing, all the calculations and logical operations are performed manually on the data. Similarly, data is transferred manually from one place to another. This method of data processing is very slow and errors may occur in the output. Mostly, is processed manually in many small business firms as well as government offices & institutions. In an educational institute, for example, marks sheets, fee receipts, and other financial calculations (or transactions) are performed by hand. This method is avoided as far as possible because of the very high probability of error, labor intensive and very time consuming. This type of data processing forms the very primitive stage when technology was not available or it was not affordable. With the advancement in technology the dependency on manual methods has drastically decreased.

Data Processing Methods – Cont'd

2. Mechanical Data Processing

In ***mechanical data processing*** method, data is processed by using different devices like typewriters, mechanical printers or other mechanical devices. This method of data processing is faster and more accurate than manual data processing. These are faster than the manual mode but still forms the early stages of data processing. With invention and evolution of more complex machines with better computing power this type of processing also started fading away. Examination boards and printing press use mechanical data processing devices frequently.

Data Processing Methods – Cont'd

3. Electronic Data Processing

Electronic data processing or EDP is the modern technique to process data. The data is processed through computer; Data and set of instructions are given to the computer as input and the computer automatically processes the data according to the given set of instructions. The computer is also known as electronic data processing machine.

This method of processing data is very fast and accurate. For example, in a computerized education environment results of students are prepared through computer; in banks, accounts of customers are maintained (or processed) through computers etc.

Data Processing Methods – Cont'd

3. Electronic Data Processing

a. Batch Processing

Batch Processing is a method where the information to be organized is sorted into groups to allow for efficient and sequential processing. Online Processing is a method that utilizes Internet connections and equipment directly attached to a computer. It is used mainly for information recording and research. Real-Time Processing is a technique that has the ability to respond almost immediately to various signals in order to acquire and process information. Distributed Processing is commonly utilized by remote workstations connected to one big central workstation or server. ATMs are good examples of this data processing method.

Data Processing Methods – Cont'd

b. Online Processing

This is a method that utilizes Internet connections and equipment directly attached to a computer. This allows for the data stored in one place and being used at altogether different place. Cloud computing can be considered as a example which uses this type of processing. It is used mainly for information recording and research.

c. Real-Time Processing

This technique has the ability to respond almost immediately to various signals in order to acquire and process information. These involve high maintenance and upfront cost attributed to very advanced technology and computing power. Time saved is maximum in this case as the output is seen in real time. For example in banking transactions.

Data Processing Methods – Cont'd

d. Distributed Processing

This method is commonly utilized by remote workstations connected to one big central workstation or server. ATMs are good examples of this data processing method. All the end machines run on a fixed software located at a particular place and makes use of exactly same information and sets of instruction.

Information Technology (IT)

Information technology (IT) is the use of any computers, storage, networking and other physical devices, infrastructure and processes to create, process, store, secure and exchange all forms of electronic data.

Types of Information Technology

The different trends within information technology include, but aren't limited to:

- Analytics
- Automation
- Artificial intelligence
- Cloud computing
- Communications
- Cyber security
- Data/database management
- Infrastructure
- Internet of things
- Machine learning
- Maintenance and repair
- Networks
- Robotics
- Software/application development
- SCADA

Why Do We Need Information Technology?

Information technology drives much of what we do in our personal and professional lives. It is the foundation of our communication, technological advancement, innovation, sustainability and recreation. We use information technology on a personal level to connect and communicate with others, play games, share media, shop and be social.

From a career perspective, information technology is largely responsible for much of our business operations and spans nearly every industry. From healthcare to food services, manufacturing to sales, and beyond, we rely on IT to help connect us to others, store and manage information and create more efficient processes.

Communication Technology (CT)

Communication Technology (CT) is the activity of designing, constructing and maintaining communication systems. It refers to all the tools used to send, receive, and process information. In today's fast climate, efficiency and convenience are the keys to successful communication technology.

Types of communication technology

Technology has reinvented the way people communicate. Originally simple devices have evolved into communication channels that create connections worldwide. There are four main types of communication technology that have contributed to the ease of sending messages: telephone, radio, television, and internet.

- **Telephone:** The telephone revolutionized verbal communication. People can talk to each other from any place in the world. As technology advanced, the device upgraded from "telephone" to "mobile phone." As the telephone progressed, it adopted new types of visual and written communication. Today, text messages and electronic versions of photos are regularly sent using mobile phones, increasing the possible amount of information being shared using phones. The telephone introduced a brand new approach to verbal, written, and visual communication, and exciting new features continue to change the communication technology game.

Types of communication technology – Cont'd

- **Radio:** About twenty years after the telephone, communicating using the radio came into play. The radio's ability to reach a large audience at a low cost continues to motivate a lot of communicators to take full advantage of the tool. Information providers, such as advertisers and newscasters, spend substantial amounts of time communicating with their massive audiences using radio technology.

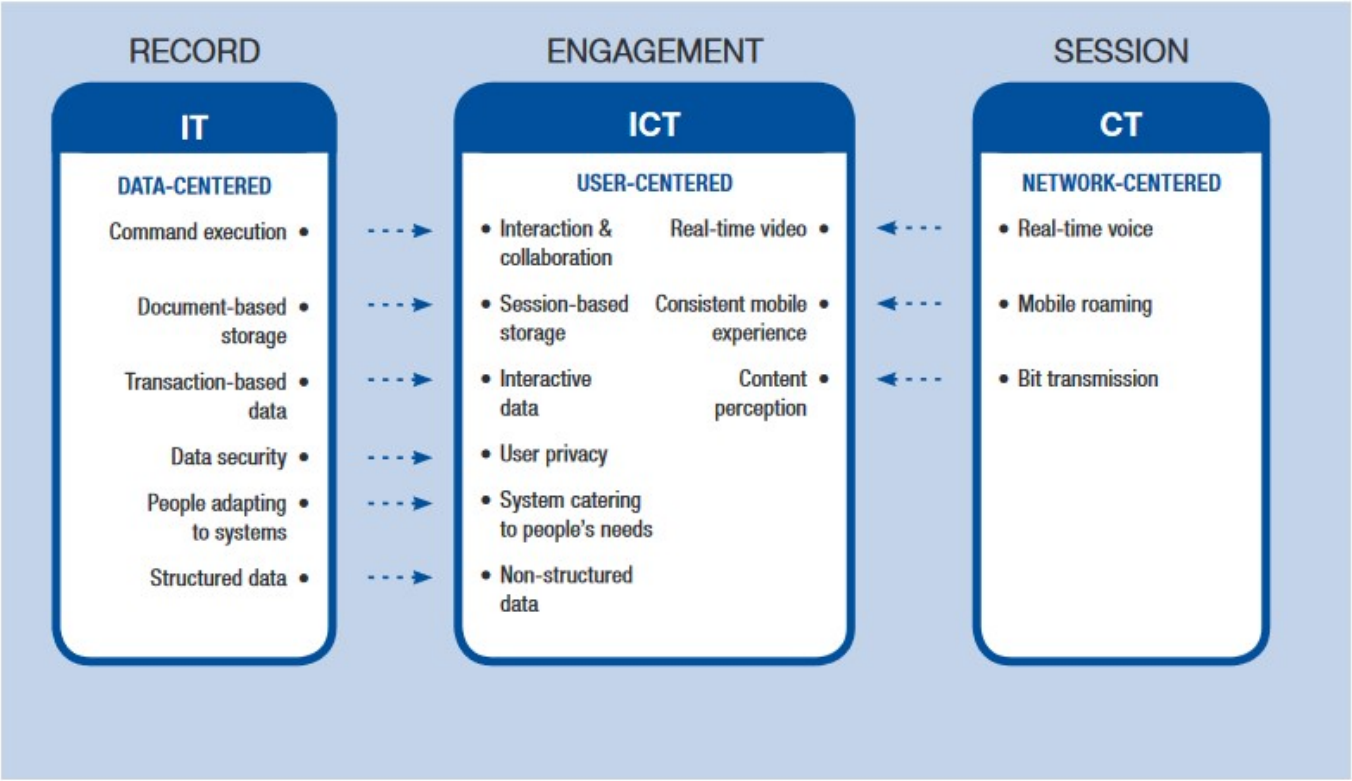
- **Television:** Television is another way to reach extensive audiences, but it brought a new perk to the table: visual communication. Some information is hard to describe using just words. Television provides audiences with the best of both worlds: information and visuals to accompany it. This advantage caused the television to replace the radio as the leading tool for mass communication.

Types of communication technology – Cont'd

- **Internet**: The tools available on the internet make any type of communication effortless. Verbal and nonverbal communication can be accomplished with video conferencing software. Written messages can be sent through email. Electronic versions of pictures can be sent to and from any internet device.

Convergence of Information Technology & Communication Technology

Convergence is a process whereby discrete elements come together to unite and produce a single system. Convergence occurred when digital media, telecommunications and computer technologies (ICTs) merged to produce ICT.



Types of Information and Communication Technology

- **Communication**
  - Telecommunications Systems
  - Satellite communication systems
  - Mobile, Video, Voice and Data Communications
  - Electronic data interchange**
  - Electronic Messaging
  - Wide Area and Local Area Networks

- **Electronic commerce- Related**
  - Internet, Intranets, and Extranets
  - Web-enabled applications for on-line shopping
  - E-commerce partnerships

Types of Information and Communication Technology – Cont'd

- **Analytical (Integrated Systems)**

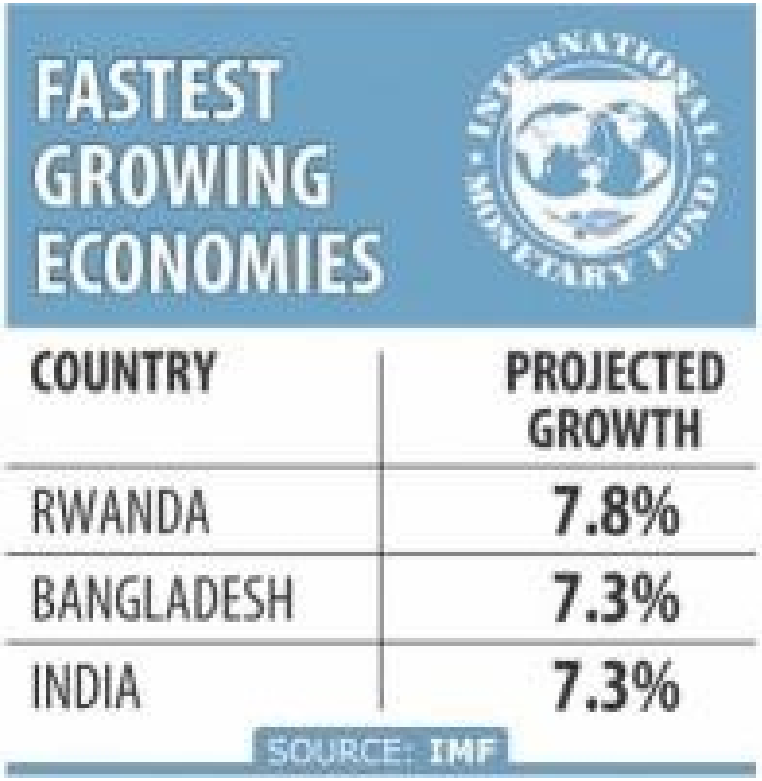
• Decision Support Systems
• Transportation and merchandise management
• Relational Databases, Data warehouses*
• On-line Analytical Processing (OLAP) tools
• Image remittance and speech recognition
• Micro-computers, and servers, workstations
• Operating systems

- **Transaction Processing/Data Capture**

• Point of sales systems
• Universal Product Code (UPC), Barcode scanners
• Check readers, Debit and Electronic Benefits Transfer (EBT) terminals
• Data capture equipment
• Electronic cash registers and terminals

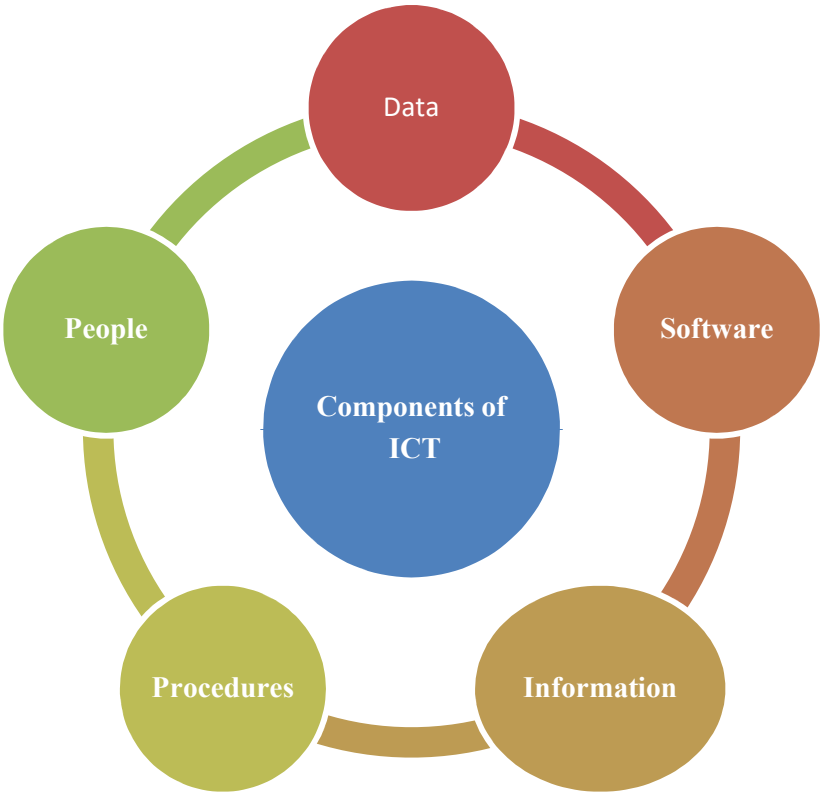
Progresses of ICT Implementation

Since “Digital Bangladesh” is an integral part of the present government’s Vision 2021, the country is committed to achieving substantial progress in the ICT sector, making “Digital Bangladesh” a reality. According to the World Bank 2019 report, Bangladesh is among the five fastest-growing economies in the world. Furthermore, the International Monetary Fund (IMF) has indicated that the economy of Bangladesh should grow at a rate of 7.3 percent this year, which is the second-highest in the world after Rwanda.



Components to an ICT System

- ✓ **Data**: raw facts and figures.
  Hardware: physical components.
- ✓ **Software**: the name given to computer programs.
- ✓ **Information**: data that is converted to give it a meaning.
- ✓ **Procedures**: a series of actions conducted in a certain order to make sure the system runs smoothly.
- ✓ **People**: data is entered by humans, for example a keyboard



Global Village

The term "global village" means all parts of the world as they are being brought together by the internet and other electronic communication interconnections.

Elements of Global Village

- Communication (Telecommunication)
- Employment (Outsourcing, Freelancing)
- Education (E-learning, Online Classes, Tele-classes)
- Health Care and Treatment (Tele-Medicine)
- Research (Identification, solution)
- Office (Virtual office)
- Residence (Smart Home)
- Business (E-commerce)
- Entertainment (News &TV Channels)
- Cultural Exchange (Social sites- Facebook, YouTube)

Role of ICT in The Present Era

There are many types of roles in the field for ICT such as:

- Data scientist
- Network Administrator
- System Administrator
- System analyst
- Technology Specialist
- Data scientist
- Database administrator
- Network engineer
- Software / Application developer
- Technical consultant
- IT Manager
- Support Analyst
- Database developer
- A software tester, Engineer, Architect
- Software Development

Special Credit goes to

Faria Rahman
M.Sc. Student of IICT

for Preparing the slide.

Thanks