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Information & Communication Technology

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PREFACE

The book 'Information and Communication Technology' has been written with a sole objective to cater to the requirements of engineering students aspiring for Engineering Services Examination (ESE) conducted annually by the Union Public Service Commission (UPSC), and preparing for State Public Service Commission as well as other competitive examinations. This book has been written keeping in mind the needs and interests of students going to write any of these top engineering competitive examinations, and the standards of the bodies conducting these examinations.

The book covers in detail the complete syllabi for these competitive examinations. For self-practice by students, questions as per the pattern of these examinations have been included in this book to help them determine the extent of their knowledge and level of preparation. To make it easier for the students to assimilate the information included in this book, all the important keywords have been printed in bold.

This revised and updated edition includes some detailed and enlarged chapters to elaborate various subjects and topics for the ease of understanding by students. This latest edition has been thoroughly scrutinised for errors in each and every chapter, and while going through it students will definitely experience the change.

Amit K. Chaudhary

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CONTENTS

CHAPTER 1

Information and Communication Technology and its Role

1.1 OVERVIEW OF ICT

INSIDE

- **Overview of ICT**
- **Different Roles of ICT**
- **Applications of ICT**
- **Role of ICT in Various Sectors**
- **Importance of ICT for Civil Society Organizations**
- **Information and Communication Technologies (ICTs) and Child Protection**

ICT stands for **Information and Communication Technology**. ICT is defined as the application of technology in processing of information and communication which includes the use of computers and softwares to not only convert and store but also process, transmit and retrieve information. It covers all the products that stores, manipulates and transmit information electronically in a digital form. For example, personal computers, radio, broadband, television, email, web based content repositories, interactive forums, learning management systems, and management information systems etc. are all classified as ICTs.

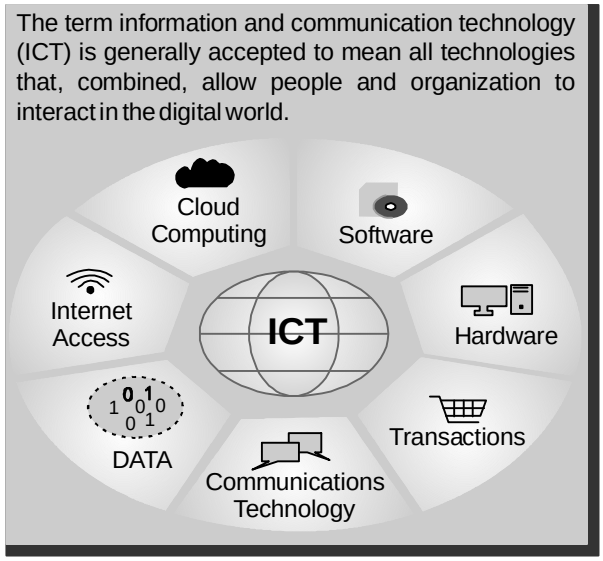

Fig. 1.1: Components of ICT.

National policy on ICT has defined it as **all devices, tools, content, resources, forums, and services, digital and those that can be converted into or delivered through digital forms, which can be deployed for realising the goals of teaching learning, enhancing access to and reach of resources, building of capacities, as well as management of the educational system**. Processes for digitisation, deployment and management of content, development and deployment of platforms and processes for capacity development, and creation of forums for interaction and exchange are parts of ICT.

- They can assist supervisors and managers with situation assessment and long-range planning and enhanced productivity in business, administration, science, engineering, military, etc.

2. Decision Support Systems (DSS)

- It is defined as the system that facilitates and enhances a manager's ability to work multiple types of knowledge. It also assists decision makers to compile useful information from raw data to identify and solve problems and make decisions.
- They can support operations, financial management and strategic decision making.

3. Geographic Information Systems (GIS)

- According to **Encyclopaedia of Earth System Sciences**, GIS is a computer-based system for the manipulation and analysis of spatial information in which there is an automated link between the data and their spatial location.
- Computer hardware and software for input, storing, transforming, retrieving, displaying and performing mathematical operations on digitized thematic data (e.g. soils, vegetation, hydrology) that have been registered to a common spatial coordinate system are the components of GIS.

4. Management Information Systems (MIS)

- It is the study of the design, implementation, management and use of information technology applications in organisations. Peter Keen defines MIS as '**the effective design, delivery and use of information systems in organisations**.' It focuses on providing managers with structured periodic reports. Much of the information is from accounting and transaction systems.

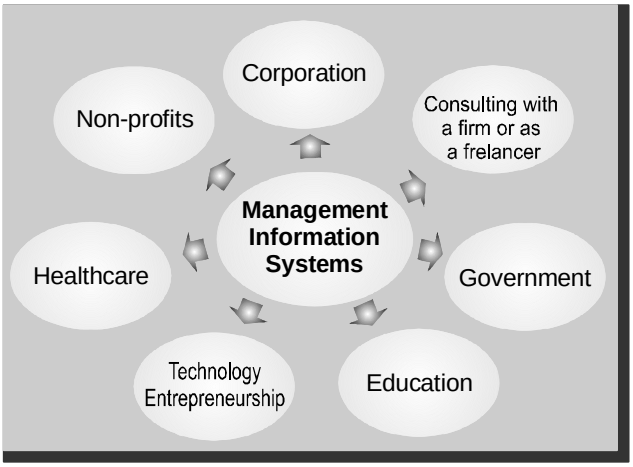

Fig. 1.2: Management Information Systems.

- Management Information System in an organization is defined as the one which takes in both internal and external data and then processes that data into useful information, which allows management to take effective decisions to achieve their goals.
- In other words, Management Information System assists the organisations to summarise, collate and graph information in order to make decisions. Thus, MIS usually consists of two parts: (a) Computer systems and software that analyze and present data and (b) Analysts that process the information along with understanding what needs to be collected.

1.4 ROLE OF ICT IN VARIOUS SECTORS

ICT finds its role and application in various sectors like engineering, administration, governance, education and multiple citizen based services.

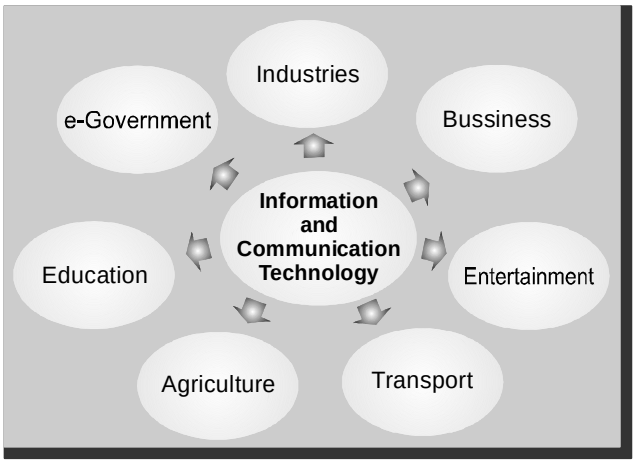

Fig. 1.3: Role of ICT in Various Areas and Sectors.

1.4.1 ICT and Engineering

- Today, in the global world, the ICT application is one of the most important parts of engineering education. Engineers can learn in a defined way by being shown how to apply the fundamentals of physics to actual machines and process that they can feel and visualize.
- Engineering discipline is the creative application of scientific innovations, which is always dynamic as new technologies are emerging often in response to the human need for development.
- The rapid pace of technological advancement gives birth to new disciplines of engineering such as nanotechnology, mechatronics or computer engineering. Engineering is regarded as the key driver to the human development.
- Thus the development of engineering skills is vital for the social and economic development. ICT

1. Qualitative and comprehensive information on departmental websites, especially in local languages. Internet and websites are used to disseminate information pertaining to various policies and programmes of the government. Government is now able to provide information to those who are living in remote and disadvantaged areas where they have no access to libraries, newspapers, etc.

   Utility services and welfare schemes available are:

   - Rural services relating to land records.
   - Police services concerning FIR registration and lost and found matters.
   - Social services relating to pension scheme, schemes for elderly and widows, schemes for Physically challenged, licenses, motor vehicle registration, ration cards, certificates relating to births and deaths, domicile, caste/tribe, etc.
   - Public information regarding employment exchange registration, employment opportunities, examination results, hospitals/ beds availability, railway time tables, airline time tables, government notifications, government forms, government schemes, etc..
   - Agricultural information on seeds, pesticides, fertilisers, crop disease, weather forecast and market price.
   - Utility payments of electricity, water and telephone.
   - Public grievances matters pertaining to civic amenities, such as electricity, water, telephone, ration card, sanitation, public transport, etc.

2. Integrated and seamless services to the citizens.
3. The single window system will provide all government services and information online at a single point, that is, web portal.
4. Public Grievance Monitoring System can be established efficiently at most of the District Offices.

Benefits of ICT in Service Delivery

1. **Government to Public interaction has increased:** Administration has become people oriented providing high quality services through a very large set of conveniently located access points.
2. **Administration has access to multiple service delivery channels now:** Government uses integrated service channels, such as, internet, website, computers, CDs, mobile and other wireless devices, television, radio, etc. in delivery of services.
3. **Openness**: Government departments have become transparent in sharing information with the people.
4. **Accountability and efficiency has increased:** Administration has now become hassle free, as they are able to dispose of cases online. With service delivery becoming integrated at both front-end and back-end, their burden of facing hundreds of people every day and being tangled in the file work has been reduced.

Disadvantages of ICT in Administration

1. Emotional quotient is removed.
2. No direct public relation is maintained.
3. Reduction in employment in informal sector.
4. Accountability for government settlement can't be easily fixed.

QUESTION

Statement (I): Information and Communication Technologies (ICTs) can facilitate improved service delivery and more efficient internal operations.

Statement (II): ICTs can create new opportunities for the marginalized and the vulnerable of society but do not represent a panacea for all development problems.

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the correct explanation of Statement (I)

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is not the correct explanation of Statement (I)

(c) Statement (I) is true but Statement (II) is false

(d) Statement (I) is false but Statement (II) is true

[ESE–2020]

Ans. (b)

Statement (I) is correct. ICTs do facilitate improved service delivery to customers in organization and citizens of the country and better efficient internal operations.

3. **Crew Management System (CMS)**: Under the system, lobbies are provided with CMS. The system serves calls daily via SMS, enabling train crews to sign on and sign off at CMS kiosks.
4. **Locomotive Management System (LMS for Diesel Locomotives) and SLAM (for Electric Locomotives):** These applications, presently implemented at a few sheds, will ultimately manage the maintenance of locomotives.
5. **Coaching/Freight Maintenance Management System (CMM/FMM):** These applications, presently implemented at pilot locations, will manage the maintenance of coaching vehicles and wagons. These applications provide convenience and transparency for the Freight Customer. They also ease the work of the Railway staff, improving overall efficiency.
   - **Section controllers** – reduced fatigue and stress through COA
   - **Running staff** – optimized crew rotation and automatic mileage calculation through CMS
   - **Track maintenance staff** – easier maintenance of records through Track Mgt System
   - **Locomotive maintenance staff**– information at fingertips through SLAM, LMS
   - **Planners** – Rake Allocation System of FOIS assists in optimal allotment of rakes
6. **E-Procurement System (EPS) including e-Auction and Reverse Auction**: Under the system, tenders are issued each month through this system and vendors are already enrolled. Scrap has been sold through the e-Auction sub-system so far.
7. **Parcel Management System (PMS)**: Booking, delivery and tracking of parcels is possible through this system, presently covering Delhi – Howrah corridor.
8. **FOIS Data Warehouse**: The Data Warehouse will enable analysis of data from FOIS to assist in strategic decision making.
9. **WISE (Workshop Management System)**: This system is under implementation in Railway Workshops, to be implemented in 34 workshops.
10. **Energy Management System**: This system is a part of the UNDP project for Energy Efficiency in Railways, which targets 15% energy saving by 2020.
11. **Track Management System**: The major components of the system are: Asset Management, rail and track monitoring and maintenance, ultrasonic testing, track renewal, patrolling, tunnels and bridges are part of this system implemented in 28 divisions.

CERT-Rail

In order to ensure that the data residing on these networks remain secure, individual nations have to set up their National Computer Emergency Response Team (CERT). The Indian CERT (CERT-in) was set up in 2003.

Indian Railways being part of the critical information infrastructure of the nation has set up the sectoral CERT called CERT-Rail to secure the various databases and networks on Indian Railway, i.e., PRS, FOIS, COIS, MIS, AFRES, PRIME, etc.

Advantages of CERT-Rail

- Creating security awareness among the users.
- Conducting training and research.
- Predicting future activity and providing early warning.
- Formulating security policies/guidelines for IR.
- Vulnerability assessment on Railway applications and networks.
- Setting up an Incident Response Team.
- Evaluating various security products for the IR, and
- Maintaining liaison with Indian Computer Emergency Response Team (CERT-in) for providing response to cyber security incidents in India.

1.4.5 ICT and Rural Development/Panchayatiraj Institutions (PRIs)

There have been many problems in rural development and Panchayatiraj Institutions related to efficiency effectively delivery of services, corruption and socio-economic development of rural masses. ICT can be a tool to remove the above loopholes in rural development and Panchayati raj institutions.

Aspects Pertaining to the Role of ICTs

- Empowerment of people through their wider participation in planning, implementation and management of programmes;

- Raise their profile
- Keep abreast of current developments and legislation in their field
- Manage and organize information more easily
- Accurately monitor their finances
- Securely maintain their users' contact details
- Understand who is using their service and how they can widen their reach
- Enable service users to support one another through online communities
- Save costs and operate more effectively allowing staff to work remotely and flexibly

NGO-DARPAN : It is a platform that provides space for interface between VOs/NGOs and key Government Ministries/Departments/ Government Bodies, to start with. Later it is proposed to cover all Central Ministries/ Departments/Government Bodies.

It is a free facility offered by the NITI Aayog in association with National Informatics Centre to bring about greater partnership between government & voluntary sector and foster better transparency, efficiency and accountability.

It started out as an initiative of the Prime Minister's Office, to create and promote a healthy partnership between VOs/NGOs and the Government of India. It is managed at present by NITI Aayog.

It has been developed by National Informatics Centre (NIC), under the aegis of Ministry of Electronics & Information Technology (MeitY), Government of India.

1.6 INFORMATION AND COMMUNICATION TECHNOLOGIES (ICTs) AND CHILD PROTECTION

- Information and Communication Technologies (ICTs) – especially internet and mobile technologies – are increasingly becoming an integral part of children's lives. More and more children rely on them to learn, engage, participate, play, work and socialise. ICTs are also proving to be useful in children's protection. They can be used to seek information on services, collect, document and share data, and report abuse. Furthermore, ICTs can have an enormous potential to overcome many of the challenges vulnerable children face in the offline world. For instance, for children with disabilities ICTs can serve as valuable tools for accessing services and offer opportunities for social inclusion, networking and participation.
- The openness of the internet coupled with the digital divide between children, parents, caregivers and teachers can, however, leave children exposed to online harm, which can negatively impact their personal development and well-being.
- This is especially the case in low and middle-income countries where gaps in overall child protection tend to be greater, and digital literacy levels among parents and caregivers lower. Examples of potential risks include exposure to disturbing or potentially harmful content such as violent images, cyberbullying, sexual solicitation ('online grooming'), circulation of child sexual abuse materials and live stream abuse.
- It is therefore important to strike a balance between opportunities and risks that the ICTs bring and to better understand what makes some children particularly vulnerable to risk of harm, so that protective strategies can be effectively targeted.
- **Role of UNICEF:** UNICEF is increasingly exploring how ICTs can be used in child protection programming such as the facilitation of birth registration, rapid family tracing and case management. UNICEF is also engaged in advocacy for the criminalization of child sexual abuse materials and online grooming of children; the strengthening of institutional capacities to implement legislation and policies related to investigation and prosecution of cases involving online sexual abuse/exploitation; supporting the establishment of comprehensive services for children abused/exploited through the internet and mobile phones; raising awareness and building capacities of children, teachers and caregivers on the risks of ICTs and protective measures and supporting research projects to enhance the understanding of children's use of ICTs and appropriate responses to violence, exploitation and abuse facilitated through ICTs.

Questions

1. Consider the following statements.

1. Application of ICT in chemical engineering includes application designing and managing plants, simplifying calculations and drawings that previously had to be done manually.
2. Application of ICT in civil engineering includes the design of mechanized systems such as power and energy systems, aerospace products, weapon systems, transport product engines, and vacuum technology.

Which of the above statement(s) is/are NOT correct?

(a) 2 only (b) 1 only
(c) Both 1 and 2 (d) Neither 1 nor 2

2. Consider the following statements related to the application of Videoconferencing tool in administration.

1. Video teleconferencing can be used to decide urgent matters in consultation with senior officers without calling them over from their offices inorder to make them accessible to the people even while being in a position to confer with other officers in urget matters.
2. It has enabled citizens' participation in decision-making.

Which of the above statement(s) is/are NOT correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2

3. Consider the following statements about the tools of e-commerce

1. Unstructured Supplementary Service Data (USSD) is a tool of e-commerce which allows mobile banking using basic feature mobile phone. Internet data is essential in this service.
2. Micro ATMs is another tool which is used by Bussiness Correspondents to deliver banking services.

Which of the following statement(s) given above is/are correct?

(a) Only 1 (b) Only 2
(c) Both 1 and 2 (d) None of the above

4. Consider the following statements related to the application of ICT in Service delivery by administration.

1. Qualitative and comprehensive information is available on departmental websites, especially in local languages due to ICT.
2. Public grievances matters pertaining to civic amenities are not included udner the online services provided by the administration.
3. ICT enabled single window system provides all government services and information online on web portal

Which of the above statement(s) is/are correct?

(a) 1 and 2 only (b) 2 and 3 only
(c) 1 and 3 only (d) None of the above

5. Which of the following statement(s) is/are the objectives of ICT in engineering?

1. ICT enables provision of flexible access to engineering through establishment of modern educational environments.
2. It fosters international and cross-sectoral knowledge, expertise and best practice exchange.

Select the correct code.

(a) 1 only (b) 2 only
(c) Neither 1 nor 2 (d) Both 1 and 2

6. Consider the following statements.

1. ICT helps administration perform its public functions by simplifying the work processes and internal functioning via internal computerization and automation, thus fostering transparency and accountability.
2. ICT also facilitates policy formulation through multi-stakeholders participation enabling administration to incorporate the ideas and suggestions of professionals, academicians, private sector, civil society organizations, media, and individuals in policy making.

Which of the above statement(s) is/are NOT correct?

(a) 1 only (b) 2 only
(c) Both 1 and 2 (d) Neither 1 nor 2