UNIT 3 ICTs: ROLES AND APPLICATIONS

Structure

3.0 LEARNING OUTCOMES

After studying this Unit, you should be able to:

- explain the roles of ICTs; and
- discuss their various applications.

3.1 INTRODUCTION

In the previous Units, you have read about the significance of ICT in governance. ICT in governance is much more than mere digitisation of processes. It is rather a 'tool' for good governance and human development. The roles of ICTs in governance are fourfold. They:

- enhance the quality and delivery of public services;
- enhance the quality of citizen-government interface;
- enable people's participation in governance; and
- provide greater access and outreach so as to include the disadvantaged in governance.

In this Unit, an attempt is made to explore the applications of ICTs, which can enable governance to achieve the above-mentioned objectives.

3.2 ROLES OF ICTs

Before embarking upon a discussion on various ICT applications, we will briefly explain the roles of ICTs.

- **Information Browsing**

  Browsing is defined as 'an exploratory, information seeking strategy that depends upon serendipity … especially appropriate for ill-defined problems and for exploring

new task domains' (G. Marchionini). Remote access systems to information databases on personal computers and via the internet have grown exponentially in the last few years. World Wide Web browsers allow a user to quickly access a wide variety of information sources. Internet contains textual as well as audio and video resources. Hence, there is a growing interest in multimedia retrieval of information today.

At present, only primitive browsing of audio/video data is possible, since there is very little structure available in digitised audio/video data. Although visual metaphors for browsing text files and images have been explored, there is little on the classification (Brazil et. al.). Moreover, there is a flip side to this information availability. Woods refers this to as the data availability paradox, as more and more data is available, but our ability to pickup what is available has not increased.

- **Electronic Publishing and Dissemination**

  Access to online databases, electronic resources, online information transactions and digitised services have revolutionised the way information is disseminated. People can access information at the click of a button.

  Electronic publishing provides for unfettered access to reliable information to academicians, researchers, practitioners and policy makers alike from any part of the world.

- **Modelling and Simulation**

  Modelling and simulation help in developing a level of understanding of the interaction of the parts of a system, and of the system as a whole. ICTs play a very important role in modelling and simulation, which are crucial in improving systems' capacities in delivering services. For example, almost all airlines look towards weather forecast for scheduling their flights in inclement weathers. Indian Meteorological Department and similarly elsewhere, the weather departments use various ICTs, supercomputers and software to produce models through simulation and are thus able to give weather forecast-most of the time pretty accurate.

  Modelling and simulation requires huge database, which are managed through various ICTs and a pattern is derived based on certain parameters, which give shape to models. A simulation generally refers to a computerised version of the model, which is run over time to study the implications of the defined interactions. Simulations are generally iterative in their development. A model is developed and then simulated and then learnings from the simulation are used to revise the model and iterations continue till an adequate level of understanding is developed. In fact, ICTs have enabled the related processes to handle complex scenarios.

- **Online Business and Government Transactions**

  Land records have been made available by many state governments. Birth and death certificates can be procured without physically visiting the government offices. One can pay his / her telephone bills over internet, saving crucial time in the process. Paying income tax or property tax is no longer a cumbersome process. All this and much more has become possible due to increased use of online business and government transactions.

Such initiatives are designed to improve the efficiency and effectiveness of the government's transactions through the use of improved technology. These e-government initiatives eliminate redundant systems and significantly improve the government's quality of services for citizens and businesses. They streamline service delivery to citizens, reduce paperwork burdens on businesses and apply the best commercial practices to improve government operating efficiency. Such projects have the potential to generate huge resources in savings by reducing operating inefficiencies, redundant spending and excessive paperwork.

- **Electronic Conferences (Meetings and Discussions)**

  Meetings and conferences provide arenas for dissemination of information and immediate presentation of new results and cutting edge research. However, there are some disadvantages to meetings- travel is expensive and this dramatically reduces the potential audience. Similarly, time constraints imposed by meetings often conflict with duties.

  Electronic conferences can offer many of the same features of traditional conferences. The main purpose of a conference is the exchange of new results. Electronic conferences offer an excellent medium for this exchange. Internet provides a robust environment for presenting information, allowing for extensive use of text, graphics, and multimedia. The major advantages of electronic conferences are their low cost and the lack of travel time. A physical conference is located at a single venue at a set period of time. Electronic conferences lift this restriction. While the web server is located at a physical site (which might be mirrored at a few other locations), the participants can access the conference from anywhere and at any time.

  After discussing the various roles, we will now explain the applications of ICTs.

3.3 APPLICATIONS OF ICTs

Various applications of ICTs enable them to perform the above-mentioned roles. These are:

- Data Base- Relational Data Base Management Systems, Knowledge Base Expert Systems;
- Decision Support Systems;
- Geographic Information Systems-Data Capture, Data Integration, Data Modelling; and
- Management Information Systems

Now we will discuss these applications in detail.

Data Base

A database is information set with a regular structure. It is usually but not necessarily stored in some machine-readable format accessed by a computer. There are a wide variety of databases, from simple tables stored in a single file to very large databases with millions of records stored in rooms full of disk drives or other peripheral electronic storage devices. Databases resembling modern versions were first developed in the 1960s.

- **Relational Data Base Management Systems (RDBMS)**

  Databases can be compiled using RDBMS so that it will be possible to subject the database to queries for more informed decision-making. It is also possible to interface such an RDBMS to a Geographic Information System of the area, which will act as a front-end so that scenario analysis results can be simulated to see the options on the GIS. Such systems can also support forecasting and predictive models, especially if time series data sets are available for such areas and communities.

  The database can form a very valuable resource, especially when it is properly archived with the facility for retrieval for specific purposes through well-designed query interfaces. (N. Vinod Chandra Menon)

- **Knowledge Base Expert Systems**

  Knowledge-Based Systems focus on systems that use knowledge-based techniques to support human decision-making, learning and action. The quality of support given and the manner of its presentation are important issues with such systems. The primary goal of expert systems is to make expertise available to decision makers and technicians to enable them to respond swiftly with effective and efficient solutions to problems. Computers loaded with in-depth knowledge of specific subjects can help in accessing information to solve a problem. The same systems can assist supervisors and managers with situation assessment and long-range planning.

  These knowledge-based applications of artificial intelligence have enhanced productivity in business, administration, science, engineering, military, etc. With advances in the last decade, expert systems clients can choose from dozens of commercial software packages with easy-to-use interfaces. Each new deployment of an expert system yields valuable data for what works in what context, thus fuelling the research that provides even better applications.

Decision Support Systems (DSS)

The systems that facilitate, expand, or enhance a manager's ability to work with one or more kinds of knowledge are called DSS. These are a specific class of computerised information system that supports decision-making activities. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or models to identify and solve problems and make decisions.

In the late 1960s, model-oriented DSS or management decision systems were found to be very useful. According to Peter Keen and Charles Stabell, the concept of decision support evolved from 'the theoretical studies of organisational decision making done at the Carnegie Institute of Technology during the late 1950s and early 1960s, and the technical work on interactive computer systems mainly carried out at the Massachusetts Institute of Technology in the 1960s.'

In an earlier article, Little had identified four criteria of robustness, ease of control, simplicity and completeness of relevant detail for designing models and systems to support management decision-making. These four criteria are used even today to evaluate modern DSS. The late 1970s developed many interactive information

systems that used data and models to help decision-makers analyse semi-structured problems. Now, DSS can use structural multidimensional data, unstructured documents and also spatial data in a system like Geodata Analysis and Display System (GADS) (Grace, 1976 and Swanson and Culnan, 1978).

Today, DSS can be designed to support decision-makers at any level in an organisation. They can support operations, financial management and strategic decision-making. There is growing interest in DSS that directly supports distributed decision-making at the group, organisation and inter-organisation levels. DSS differ with respect to the kinds of knowledge they help manage. While majority of conventional DSS have been devised to help manage primarily descriptive and procedural knowledge, there is a class of artificially intelligent DSS, which focuses on representation and processing of reasoning knowledge. However, it may be noted that often DSS are created to solve particular problems on an adhoc processing basis and are not needed on a regular basis.

Geographic Information Systems (GIS)

A geographic information system or geographical information system is a system for creating and managing spatial data and associated attributes. In the strictest sense, it is a computer system capable of integrating, storing, editing, analysing, and displaying geographically referenced information. 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. A GIS consists of computer hardware and software for entering, storing, transforming, measuring, combining, retrieving, displaying and performing mathematical operations on digitised thematic data (e.g. soils, vegetation, hydrology) that have been registered to a common spatial coordinate system.' In a more generic sense, GIS is a 'smart map' tool that allows users to create interactive queries (user created searches), analyse spatial information and edit data.

- **Data Capture**

  GIS data represents real world objects (roads, land use, elevation) with digital data. A GIS can also convert existing digital information, which may not yet be in map form, into forms it can recognise and use. For example, digital satellite images generated through remote sensing can be analysed to produce a map-like layer of digital information.

  Existing data printed on paper or PET film maps can be digitised or scanned to produce digital data. A digitiser produces vector data as an operator traces points, lines and polygon boundaries from a map. Scanning map results in raster data that could be further processed to produce vector data. Survey data can be directly entered into a GIS from digital data collection systems on survey instruments. Positions from a Global Positioning System (GPS), another survey tool, can also be directly entered into a GIS. Remotely sensed data also plays an important role in data collection and consists of sensors attached to a platform. Sensors include cameras, digital scanners etc., while platforms usually consist of aircraft and satellites.

  Satellite remote sensing provides another important source of spatial data. Here satellites use different sensor packages to measure the reflectance from parts of the

electromagnetic spectrum or radio waves that were sent out from an active sensor, such as, radar. Remote sensing collects raster data that can be further processed to identify objects and classes of interest, such as land cover. When data is captured, the user should consider if the data should be captured with either a relative accuracy or absolute accuracy, since this could not only influence how information will be interpreted but also the cost of data capture.

- **Data Integration**

  In addition to collecting and entering spatial data, attribute data is also entered into a GIS. For vector data this includes additional information about the objects represented in the system. After entering data into a GIS, it usually requires editing, to remove errors or further processing. For vector data it must be made 'topologically correct' before it can be used for some advanced analysis. For example, in a road network, lines must connect with nodes at an intersection. Errors such as, undershoots and overshoots must also be removed. For scanned maps, blemishes on the source map may need to be removed from the resulting raster.

- **Data Modelling**

  It is impossible to collect data over every square metre of the Earth's surface. Therefore, samples must be taken at discrete locations. GIS can be used to depict two and a three-dimensional characteristic of the Earth's surface, subsurface and atmosphere from points where samples have been collected.

GIS can provide a great deal more problem-solving capabilities than using a simple mapping programme or adding data to an online mapping tool. The Website GIS.com suggests that GIS can be viewed in three ways:

- **Database View**

  A GIS is a unique kind of database of the world–a geographic database (geodatabase). It is an 'Information System for Geography.' Fundamentally, a GIS is based on a structured database that describes the world in geographic terms.

- **Map View**

  A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Maps of the underlying geographic information can be constructed and used as 'windows into the database' to support queries, analysis and editing of the information. This is called geovisualisation.

- **Model View**

  A GIS is a set of information transformation tools that derive new geographic datasets from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets.

  In other words, by combining data and applying some analytic rules, one can create a model that helps find solutions to problems being faced. Today, many local bodies in India are using GIS data for city development planning.

Management Information Systems (MIS)

MIS 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. Apparently, MIS are not concerned with day-to-day operations, but rather with the management of activities that do support operations.

MIS became extremely relevant with the emergence of global economy, where the managers / administrators can no longer afford to ignore how the information is handled by their organisations. Expectations of the people have also increased in terms of more and better services with lesser costs. Laudon and Laudon identify three activities associated with producing information for making decisions, controlling operations, analysing problems and creating new products or services. These are:

- **Input**: it captures or collects raw data from within the organisation or from its external environment;
- **Processing***:* it converts raw input into a more meaningful form; and
- **Output***:* it transfers the processed information to the people or activities where it will be used.

Feedback emanating from the use of this information serves as the input for the same process again.

Today, we are using second generation of MIS. First generation MIS were concerned with the capture of information and experience so that it was easily accessible. Technology had primacy in this phase. Emphasis was given to developing sophisticated data analysis and retrieval systems with little concern towards how the information they contained would be developed or used. This led to the theoretical and practical failure of first generation techniques to live up to its promise. How well information is organised allows individuals to understand and make sense of it or leaves them lost in a maze of irrelevant information overload. Consequently, the attention was paid towards developing system that gave priority to the way in which people construct and use knowledge. This is the second generation MIS.

Characteristics of MIS

Some of the important characteristics of modern MIS are given below:

- MIS are management oriented, where the management concerns all the employees of the organisation. The system is designed from top to bottom. Development of the system starts from appraisal of organisational needs and its objectives;
- management actively directs, reviews and participates in system development efforts to ensure that the implemented information system meets the requirements of the organisation.
- an integrated system and MIS are not synonymous. However, the integrated concept is a necessary characteristic of MIS;

- due to the integrated nature of MIS, it is prudent to capture relevant data close to the source where the event occur and use it throughout the functional areas. The common data flow concept supports several tenets of systems analysis- avoiding duplication, combining similar functions and simplifying necessary functions, wherever necessary;
- while the integrated approach makes it appear a single entity, it is broken down into desirable sub-systems;
- MIS needs to be planned carefully and evolves in due course of time;
- MIS should be developed with the flexibility so that future changes in the organisational needs may be accommodated in the system; and
- MIS includes every type of systems that gives information, whether it is formal or informal (Srivastava).

Components of MIS

There are five components of MIS:

- **Hardware**- the physical equipment used in computing;
- **Software**- the set of instructions that controls the hardware;
- **People-** in the early days of computers, programmers, design analysts and a few external users were directly involved in MIS. Today, almost everyone in the organisation is involved with the information system;
- **Procedures**- are instructions that help people use the systems. They include items such as, users manuals; and
- **Databases**- are collections of related data that can be retrieved easily and processed by the computers.

MIS: Some Challenges

Some of the challenges pertaining to the use of MIS are mentioned below:

- **How to use information technology to design organisations to introduce new products and improve service delivery?**

  Technical change moves much faster than the individuals and organisations. It becomes difficult to adapt to these changes in a large bureaucracy. Various restructuring efforts by various levels of government world over indicate the need for redesigning the organisations in order to become competitive in introducing new products or improving the service delivery from the existing standards.

- **How to understand the system requirements in a global economic environment?**

  In the new world order if a government takes a decision, it also has to conform to several international agreements. MIS needs to incorporate those critical features so that the required inputs are available to policy maker and products remain competitive.

To develop integrated MIS, organisations need to have access to global level hardware, software and communication standards.

- **How to develop the architecture of MIS that helps in achieving goals?**

  While information technology can suggest new ways of doing things, organisations need to have a clear picture of their objectives and how these can be supported best by MIS. Many organisations are not able to meet their goals because they are crippled by incompatible computer hardware, software and information systems. Integrating these 'islands of information' into a coherent architecture is now a priority.

- **How to secure investments for new MIS?**

  A look at the budget of various ministries would reveal the kind of investment that is required to put effective MIS in place. It requires massive investment from government both for hardware and software. Besides, people have to be trained so that most optimal use of resources can be made by the organisations. Developing countries, like India, have problems of resource constraint. This challenge can be overcome only if the business value of information systems can be ensured.

- **How to ensure that MIS are used in an ethically and socially responsible manner?**

  Information systems need to be designed in a manner that they function as intended but at the same time it needs to be ensured that health, safety, job security and social well being are considered as carefully as meeting the organisational objectives.

3.4 CONCLUSION

ICTs have penetrated all areas of governance and have made management of information and knowledge and service delivery more efficient, cost-effective and virtually real time. Design and development of databases, GIS, MIS and DSS has made governance more dynamic and functional. Internet and websites have facilitated easy information browsing, electronic information publishing and dissemination, speedy governmental and commercial transactions, meetings, discussions, etc. IT interfaces with satellite communication has further enabled facilities of e-learning, e-training and teleconferencing.

Thus, ICT applications have prompted effective decision-making, policy analysis and problem solving by governments at all levels and across the globe. Appropriate use of such applications can have a substantial impact and improve governance qualitatively.

3.5 ACTIVITY

1. Discuss among your peer group about the usability of database in e-governance.
2. Cite an example of a project where GIS and MIS have been used in policy planning and implementation.

3.6 KEY CONCEPTS

Vector data : a coordinate-based data structure commonly used to represent map features. Each liner feature is represented as a list of ordered x, y coordinated. They are mathematical descriptions of geometric entities and are employed by applications like Geographic Information Systems (GIS), Computer-Aided Design (CAD), and Computer-Aided Manufacturing (CAM).

PET Film : this is a kind of polyester and acronym of Polyethylene terephthalate.

Raster Data : is a method of storing, representing or displaying spatial data in digital form. It consists of using cell data (not necessarily square) arranged in a regular grid pattern in which each unit (pixel or cell) within the grid is assigned an identifying value based on its characteristics.

Attribute Data : data that relate to a specific, precisely defined location. Attributes data are qualitative data that can be counted for recording and analysis. The data are often statistical but can also be in text, images or multi-media. These are linked in the GIS to spatial data that define the location.

3.7 REFERENCES AND FURTHER READINGS

- Brazil, E., J., M., Fernström, G., Tzanetakis, and P., Cook, 2002, Enhancing Sonic Browsing Using Audio Information Retrieval, presented at International Conference on Auditory Display, ICAD-02, Kyoto, Japan.
- Encyclopaedia of Earth System Sciences, vol. 2, p. 329.
- Grace, B., F., 1976, Training Users of a Decision Support System, IBM Research Report RJ1790, IBM Thomas J. Watson Research Laboratory, USA
- Keen, Peter, G.,W., 1980, MIS Research: Reference Disciplines and a Cumulative Traditions, Proceedings of the First International Conference on Information Systems, E., Pharaim, and R., McLean, (eds.) Philadelphia, PA.
- Keen, P., G., W., and M., S., Scott Morton, 1978, Decision Support Systems: An Organisational Perspective, Reading, MA: Addison-Wesley, Inc.
- Kroenke, David, 1992, Management Information Systems, McGraw Hill, New Delhi
- Laudon, K.,C., and J.,P., Laudon, 1998, Management Information Systems: Organisation and Technology, Prentice Hall of India, New Delhi

- Little, J., D., C., Models and Managers: The Concept of a Decision Calculus, Management Science, vol. 16, no. 8, pp. B466-485, April 1970
- Marchionini, G., 1995, Information Seeking in Electronic Environments, New York, The Press Syndicate of the University of Cambridge, USA
- Srivastava, P., 2004, Management Information Systems: A New Framework, Shree Niwas Publications, Jaipur
- Swanson, E., B., and M., J., Culnan, 1978, Document-Based Systems for Management Planning and Control: A Classification, Survey, and Assessment, MIS Quarterly, vol. 2, no. 4, December, pp. 31-46, n.p.
- Woods, D., D., E., S., Patterson, E., M.,Roth, and K., Christoffersen, 1999, Can We Ever Escape from Data Overload, presented at 43rd Annual Meeting on Human Factors and Ergonomics Society, Houston, Texas
- Menon, N., V., C., 2003, Applications of Information Technology in Disaster Risk Reduction, in P., Sahni, and Madhavi Malalgoda Ariyabandu, (eds.), Disaster Risk Reduction in South Asia, Prentice Hall of India, New Delhi

ICT AND ADMINISTRATION