2
History and Evolution

It has taken several years for Geographical Information Technology (GIT) to evolve into its present state. Human history has very close link with earth's geography. GIT has been necessary for different purposes all along the history of human civilization to maintain land ownership records and demarcations, mineral exploration, military requirement, and navigation in high sea by sailors. The present chapter gives a historical account of the evolution of GIT.

ANCIENT PERIOD

Since the beginning of land ownership, boundary markers have been required to separate one property from another. From the records of ancient history dating 3000BC show the presence of surveyors in all ancient civilizations of China, India, Babylon and Egypt. Map making, collection, and compilation of space related data and calculations date back thousands of years. The earliest known maps were drawn on parchment of a gold mine in Egypt during the period of Rameses II (1292-1225BC).

The Egyptian surveyors, known as *harpedonapata* (rope stretcher) were in continuous demand as the boundary marks were used to be destroyed regularly by the Nile's annual flood. Early surveyors used many techniques for precision land measurement. One such technique was ropes with knots tied at set graduations to measure distance. Ropes were also used to lay out right angles. The early surveyors discovered that 3:4:5 ratio provided right angled triangles. A 12 unit rope in the above proportion would have knots tied at unit positions 3 and 4 to make a right angle triangle. Another useful ancient surveying instrument consisted of three pieces of wood in the form of an isosceles triangle, with the base extended in both directions with a cut notch at the mid point and a plumb bob suspended from the apex of the frame. The bob matched with the notch when the base was level. Ancient Egyptians used many such levels and measuring tools for the construction of the great pyramids.

Fa-hsien, Hsuan–tsang, etc. made a tremendous contribution in depicting South Asian geography.

The preparation of authentic maps, and record keeping of land related information and data gradually became extremely important to different civilizations across the globe. The earliest maps were drawn mostly to facilitate sea voyages. The European cartography declined with the fall of the Roman Empire. During middle ages, Arabs were the leading cartographers. The travels and explorations of Marco Polo, Christopher Columbus, Vasco da Gama, and others resulted in trade connections between different countries across the globe. As a result, more maps were required for the unmapped regions of the world. The need for geographical information increased with the increased requirement of mineral and other resources in post-industrial revolution period. The European countries started building colonies in Africa, Asia, South America and North America for exploitation of natural resources, which led to the development of accurate mapping of land and sea.

In military ordinance development, the introduction of artillery made maps very crucial for military operations and the military became the leading mapmakers. In many countries, the military mapmakers became responsible for both topographic land maps and navigational charts. Even in recent times the trend remains same, the official mapmaking agencies are partly under the control of defence establishment. In India, the official map making organization, Survey of India, is closely associated with the Defence establishment although it comes under Ministry of Science and Technology. In fact, nearly one-fourth of India's surveyed toposheets, mainly of the bordering areas are beyond the reach of civilians as these are marked as restricted areas and permission is required from Ministry of Defence for their use.

MODERN PERIOD

Till 19th century the use of geographical information was used primarily for trade, explorations, tax collections, and for military operations. From the middle of 19th century with the change of global economic and geopolitical situation, need for geographical information arose with the requirement of new infrastructures like road, railways, telecom connections, oil and gas pipelines, water and sewerage lines, etc. Planning for these infrastructures required detailed terrain information, which were not commonly available. Development became increasingly dependant on socio-economic factors. In independent India the rights of land and its distribution became a crucial issue with the land reforms act. With the development and continuous changes of the land use, faster mapping and registry of data for

on the analysis of various types of geographical data like distribution of natural resources, demographic pattern, socio-economic profile, social benefit, livelihood provision, infrastructure, etc. The Canadian government created the first geographical information system in late 1960s. It used mainframe computers and its output was in the form of tables. Compared to the present day systems it was crude and expensive. Later, in United States of America, a similar system was used to process natural resource data, known as MIDAS.

Various urban utilities in modern cities like water supplies, sewage networks, electricity, transportation, and telecommunication add complexity to the system with the expansion of the city and these multiply the requirement of reliable geographic data for planning and management of the utilities.

The development of integrated circuits in the early 1960s and early 1970s created more powerful *third generation* computers. This brought computers to all professional disciplines, especially where large amount of data required to be processed.

The *fourth generation* desktop computers came into existance in 1974 after the development of microprocessor in 1971–1972. Seven years later, desktop computer was launched as Personal Computer (PC). The development of powerful workstations in the mid 1980s led to an increasing rate of use of GIS. The overall development trend was best reflected in the cost of computing: a computer's processing and storage capabilities cost US$ 100,000 in 1960, but could be purchased for US$ 10 in 1984 and US$ 0.005 in 1997, i.e. cost efficiency increased by a factor of 10 every two to three years.

DEVELOPMENT OF REMOTE SENSING

Aerial surveys became very popular after World War II. This technique efficiently performs large-scale topographic surveys. Satellite land imagery commenced nearly 15 years after the successful launch of first human made artificial satellite. In human history, the successful launch of ***Sputnik I*** on 4 October 1957, by the erstwhile Soviet Union is one of the most significant event. The world's first artificial satellite, the size of a basketball, weighed only 183 pounds, and took about 98 minutes to orbit the Earth on its elliptical path. This launch began a new technological and scientific era. While the Sputnik launch was a single event, it marked the start of the space age and the US-USSR space race.

The Sputnik launch had tremendous geopolitical impact. As a technical achievement, Sputnik caught the world's attention and the USA off-guard. They feared that the Soviets' ability to launch satellites also translated into higher capability arms like ballistic missiles. Then the Soviets launched

Sputnik II on 3 November carrying a heavier payload, including a dog-named Laika.

A competition began and on 31 January 1958 the United States successfully launched ***Explorer I*** with small scientific payload. It eventually discovered the magnetic radiation belts around the Earth, named after principal investigator James Van Allen. The Explorer program continued as a successful ongoing series of lightweight, scientifically useful spacecraft.

In July 1958, USA, the established National Aeronautics and Space Administration (NASA) the centre for space research. NASA did pioneering work in space applications such as communications satellites in the 1960s. The Echo, Telstar, Relay, and Syncom satellites were built by NASA or by American firms based on significant NASA developments.

In the 1970s, the LANDSAT program of NASA literally changed the way we look at our planet Earth. The initial three LANDSAT satellites were launched in 1972, 1975, and 1978. These satellites transmitted back to Earth data streams related to earth surface and that could be converted into coloured pictures. Landsat data was used in a number of scientific and commercial applications such as crop management, fault line detection, and monitoring climatic events like droughts, forest fires, and glacier movement. NASA also involved in a variety of other Earth Science endeavours such as the Earth Observation System of spacecraft and data processing that have yielded important scientific results in such areas as tropical deforestation, global warming, and climate change.

With various space program by NASA and other countries different types of satellites have been developed for specific applications like Communications Satellites**,** Weather Satellites, Earth Science Satellites, etc.

INDIAN SPACE RESEARCH

In India, remote sensing data of foreign satellites like LANDSAT, NOAA, SPOT etc. were used for various scientific studies on natural resources and other developmental activities. First Indian experimental satellite Aryabhatta was Launched in 19 April, 1975 by Soviet-intercosmos rocket. On 7 June, 1979 Bhaskara I Satellite was lounched. It was a low orbit earth observation setellite. Subsequently, Bhaskara II was launched in 1981. In 1979 Earth Station (Data Receiving Centre) at Hyderabad was built and data reception started from LANDSAT satellite. In March 1988, India launched its first civilian remote sensing satellite IRS-1A, which marked the beginning of the Indian Space Programme. Satellite IRS-1B was launched in August 1991 in the same series. Both IRS-1A and 1B provided valuable data related to large scale mapping of the earth surface. IRS-1C was launched in December 1995 and IRS-1D was launched in September 1997, further strengthening