NATIONAL OPEN UNIVERSITY OF NIGERIA

FACULTY OF HEALTH SCIENCES

DEPARTMENT OF ENVIRONMENTAL HEALTH SCIENCES

COURSE CODE: EHS 313

COURSE TITLE: ENVIRONMENTAL HEALTH INFORMATION SYSTEM (EHIS)

COURSE GUIDE

EHS 313: ENVIRONMENTAL HEALTH INFORMATION SYSTEM (EHIS)

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COURSE GUIDE

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INTRODUCTION

EHS 313 is Environmental Health Information system and is a 2unit Course. Environmental Health System is defined as the system of all 'actors' (stakeholders), institutions, and resources that undertake "environmental health actions" – i.e. actions whose primary purpose is to promote, restore, or maintain the environmental factors that will affect the health of a population. It is an information system specially designed to assist in the management and planning of environmental health programs to enhance service delivery.

Environmental Health Information centers help to evaluate and access existing information sources, provide additional products, and contribute more directly to health promotion, e.g. via Environmental Health reporting and planning involvement.

WHAT YOU WILL LEARN IN THIS COURSE

In this course, you have the course units and a course guide. The course guide will tell you what the course is all about. It is general overview of the course materials you will be using and how to use those materials. It also helps you to allocate the appropriate time to each unit so that you can successfully complete the course within the stipulated time limit.

The course guide also helps you to know how to go about your Tutor- Marked assignment which will form part of your overall assessment at the end of the course. Also, there will be regular tutorial classes that are related to this course, where you can interact with your facilitator and other students. Please, I encourage you to attend these tutorial classes.

COURSE AIM

The course aims to give you an understanding of Environmental Health information system and its application in Environmental Health practice.

COURSE OBJECTIVES

To achieve the aim set above, there are objectives. Each unit has a set of objectives presented at the beginning of the unit. These objectives will give you on what to concentrate / focus on while studying the unit. Please read the objective before studying the unit and during your study to check your progress.

The comprehensive objectives of the Course are given below. By the end of the course/after going through this course, you should be able to understand:

i. Define the term Environment. Environmental Health and Environmental Health information system
ii. Understand the frame work of Environmental Health information system
iii. Environmental health tracking network
iv. Geographical information system and its application in Environmental Health practice
v. The concepts Environmental Health Information system its procedure and structure
vi. Know the contemporary Environmental Health Information systems as used in morbidity surveys, diseases surveillance system, diseases register etc.
vii. Appreciate the computer simulation and life-table techniques
viii. Know how to manage Medical and Health data- base
ix. Understand the applications of intranet and internet
x. Understand the use of Electronic Library system
xi. Appreciate the application of Geo- information technology in Environmental health practice
xii. Appreciate geo- informatics globalization and teleconferencing

WORKING THROUGH THIS COURSE

To successfully complete this course, you are required to read each study unit, read the textbooks and materials provided by the National Open University of Nigeria. Reading the referenced materials can also be of great assistance. Each unit has self-assessment exercises which you are advised to do and at certain periods during the course you will be required to submit your assignment for the purpose of assessment.

There will be a final examination at the end of the course. The course should take you about 17 weeks to complete. This course guide will provide you with all the components of the course, how to go about studying and hour you should allocate your time to each unit so as to finish on time and successfully.

THE COURSE MATERIALS

The main components of the course are:

The Study Guide

- Study Units
- Reference / Further Reading
- Assignments
- Presentation Schedule

STUDY UNITS

The study units in this course are outlined below:

MODULE 1 Define the following the terms:

Environment, Environmental Health and Environmental Health information system

Unit 1: Understanding the concept Environmental Health information system EHIS and framework of EHIS

Unit 2: Know the contemporary Environmental information systems as used in morbidity surveys, diseases surveillance and disease register

Unit 3: Appreciate the application of Geographical information system and global positioning in Environmental Health practice

MODULE 2 MODULE Computer simulation and life table techniques

Unit 1: Understand how to managed Medical and Health Data base

Unit 2: Application of GIS in Environmental Health practice

Unit 3: Understand the use application intranet and internet

Unit 4: Use of electronic library system

Unit 5: Appreciate geo-informatics globalization and teleconferencing

There are activities related to the lecture in each unit which will help your progress and comprehension of the unit. You are required to work on these exercises together with the TMAs to enable you achieve the objectives of each unit.

ASSIGNMENT FILE

There are two types of assessments in this course. First are the Tutor-Marked Assessments (TMAs); second is the written examination. In solving the questions in the assignments, you are expected to apply the information, knowledge and experience acquired during the course. The assignments must be submitted to your facilitator for formal assessment in accordance with prescribed deadlines stated in the assignment file.

The work you submit to your facilitator for assessment accounts for 30 percent of your total course mark. At the end of the course, you will be required to sit for a final examination of 1½ hours duration at your study center. This final examination will account for 70 % of your total course mark.

PRESENTATION SCHEDULE

There is a time-table prepared for the early and timely completion and submissions of your TMAs as well as attending the tutorial classes. You are required to submit all your assignments by the stipulated time and date. Avoid falling behind the schedule time.

ASSESSMENT

There are three aspects to the assessment of this course. The first one is the self-assessment exercises. The second is the tutor marked assignments and the third is the written examination or the examination to be taken at the end of the course. Do the exercises or activities in the unit by applying the information and knowledge you acquired during the course. The tutor-marked assignments must be submitted to your

facilitator for formal assessment in accordance with the deadlines stated in the presentation schedule and the assignment file. The work submitted to your tutor for assessment will count for 30% of your total course work. At the end of this course, you have to sit for a final or end of course examination of about a three-hour duration which
will count for 70% of your total course mark.

TUTOR-MARKED ASSIGNMENTS

This is the continuous assessment component of this course and it accounts for 30% of the total score. You will be given four (4) TMAs by your facilitator to answer. Three of which must be answered before you are allowed to sit for the end of course examination.
These answered assignments be returned to your facilitator. You're expected to complete the assignments by using the information and material in your readings references and study units. Reading and researching into your references will give you a wider view-point and give you a deeper understanding of the subject.

1. Make sure that each assignment reaches your facilitator on or before the deadline given in the presentation schedule and assignment file. If for any reason you are not able to complete your assignment, make sure you contact your facilitator before the assignment is due to discuss the possibility of an extension. Request for extension will not be granted after the due date unless there in exceptional circumstances.

2. Make sure you revise the whole course content before sitting or the examination. The self-assessment activities and TMAs will be useful for this purposes and if you have any comment please do before the examination. The end of course examination covers information from all parts of the course.

COURSE MARKING SCHEME

Assignments	Marks
Assignments 1 - 4	Four assignments, best three marks of the four count at 10% each = 30% of course marks
End of course examination	70% of overall course marks
Total	**100% of course materials**

Table 2: Course Organization

Unit	Title of Work	Weeks Activity	Assessment (End of Unit)
	Course Guide	Week	
1	Concept of Environmental Health information system	Week 1	Assignment 1
2	Frame work of Environmental Health information system and EH tracking	Week 2	Assignment 2
3	Geographical information system and its application in EHP	Week 3	Assignment 3
4	Contemporary Environmental health information system as used morbidity	Week 4	Assignment 4
5	Computer simulation and life- table techniques	Week 5	Assignment 5
6	Management of Medical and Health Data-base	Week 6	Assignment 6
7	Use of Electronic Library system	Week 7	Assignment 7
8	Application of Geo- information technology in EH	Week 8	Assignment 8
9	Geo- informatics globalization and	Week 9	Assignment 9

	teleconferencing		

HOW TO GET THE MOST OUT OF THIS COURSE

In distance learning, the study units replace the university lecturer. This is one of the huge advantages of distance learning mode; you can read and work through specially designed study materials at your own pace and at a time and place that suit you best. Think of it as reading from the teacher, the study guide tells you what to read, when to read and the relevant texts to consult. You are provided exercises at appropriate points, just as a lecturer might give you an in-class exercise.

Each of the study units follows a common format. The first item is an introduction to the subject matter of the unit and how a particular unit is integrated with the other units and the course as a whole. Next to this is a set of learning objectives. These learning objectives are meant to guide your studies. The moment a unit is finished, you must go back and check whether you have achieved the objectives. If this is made a habit, then you will significantly improve your chances of passing the course.

The main body of the units also guides you through the required readings from other sources. This will usually be either from a set book or from other sources.

Self-assessment exercises are provided throughout the unit, to aid personal studies and answers are provided at the end of the unit. Working through these self-tests will help you to achieve the objectives of the unit and also prepare you for tutor marked assignments and examinations. You should attempt each self-test as you encounter themin the units.

The following are practical strategies for working through this course:

1. Read the Course Guide thoroughly.

2. Organize a study schedule. Refer to the course overview for more details. Note the time you are expected to spend on each unit and how the assignment relates to the units. Important details, e.g. details of your tutorials and the date of the first day of the semester are available. You need to gather together all this information in one place such as a diary, a wall chart calendar or an organizer. Whatever method you choose, you should decide on and write in your own dates for working on each unit.

3. Once you have created your own study schedule, do everything you can to stick to it. The major reason that students fail is that they get behind with their course works. If you get into difficulties with your schedule, please let your tutor know before it is too late for help.

4. Turn to Unit 1 and read the introduction and the objectives for the unit.

5. Assemble the study materials. Information about what you need for a unit is given in the table of contents at the beginning of each unit. You will almost always need both the study unit you are working on and one of the materials recommended for further readings, on your desk at the same time.

6. Work through the unit, the content of the unit itself has been arranged to provide a sequence for you to follow. As you work through the unit, you will be encouraged to read from your set books.

7. Keep in mind that you will learn a lot by doing all your assignments carefully. They have been designed to help you meet the objectives of the course and will help you pass the examination.

8. Review the objectives of each study unit to confirm that you have achieved them. If you are not certain about any of the objectives, review the study material and consult your tutor.

9. When you are confident that you have achieved a unit's objectives, you can start on the next unit. Proceed unit by unit through the course and try to pace your study so that you can keep yourself on schedule.

10. When you have submitted an assignment to your tutor for marking, do not wait for its return before starting on the next unit. Keep to your schedule. When the assignment is returned, pay particular attention to your tutor's comments, both on the

tutor-marked assignment form and also that written on the assignment. Consult you tutor as soon as
possible if you have any questions or problems.

11. After completing the last unit, review the course and prepare yourself for the final examination. Check that you have achieved the unit objectives (listed at the beginning of each unit) and the course objectives (listed in this course guide).

FACILITATORS/TUTORS AND TUTORIALS

Sixteen (16) hours are provided for tutorials for this course. You will be notified of the dates, times and location for these tutorial classes. As soon as you are allocated a tutorial group, the name and phone number of your facilitator will be given to you.

These are the duties of your facilitator: He or she will mark and comment on your assignment. He will monitor your progress and provide any necessary assistance you need. He or she will mark your TMAs and return to you as soon as possible. You are expected to mail your tutored assignment to your facilitator at least two days before the
schedule date.

Do not delay to contact your facilitator by telephone or e-mail for necessary assistance if you do not understand any part of the study in the course material. You have difficulty with the self-assessment activities. You have a problem or question with an assignment or with the grading of the assignment.

It is important and necessary you acted the tutorial classes because this is the only chance to have face to face content with your facilitator and to ask questions which will be answered instantly. It is also period where you can say any problem encountered in the course of your study.

FINAL EXAMINATION AND GRADING

The final examination for EHS 313: Environmental Health Information System will be of 1½ hours duration. This accounts for 70 % of the total course grade. The examination will consist of questions which reflect the practice, exercises and the tutor-marked assignments you have already attempted in the past. Note that all areas of the course will be assessed. To revise the entire course, you must start from the first unit to the last unit in order to get prepared for the examination. It may be useful to go over your TMAs and probably discuss with your course mates or group if need be. This will make you to be more prepared, since the examination covers information from all aspects of the course.

MODULE 1: Define the following the terms:

Environment, Environmental Health and Environmental Health information system

Unit 1: Understanding the concept Environmental Health information system and framework of EHIS

Unit 2: Know the contemporary Environmental information systems as used in morbidity surveys, diseases surveillance and disease register

Unit 3: Appreciate the application of Geographical information system and global positioning in Environmental Health practice

UNIT 1 Environmental health information system

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1.0 Introduction

2.0 Objectives

3.0 Main content

3.1 Definitions, and description of Environment, Environmental Health and Environmental Health information system

3.2 Frame work for Environmental Health information system, tools for information data collection and EH tracking

3.3 Geographical information system

4.0 Conclusion

5.0 Summary

6.0 Tutor-Marked Assignment

7.0 References/Further Reading

1.0 INTRODUCTION

ENVIRONMENTAL HEALTH INFORMATION SYSTEM

Thisis defined as the system of all ‘actors’ (stakeholders), institutions, and resources that undertake “environmental health actions” – i.e. actions whose primary purpose is to promote, restore, or maintain the environmental factors that will affect the health of a population

ENVIRONMENTAL HEALTH INFORMATION SYSTEM

“A system that provides specific environmental health information support to the decision-making process at each level of a health delivery organization.”

ENVIRONMENTAL HEALTH MANAGEMENT INFORMATION SYSTEM:

An information system specially designed to assist in the management and planning of environmental health programs to enhance service delivery.

2.0 OBJECTIVES

By the end of this unit, you will be able to:

- Define the term Environment. Environmental Health and Environmental Health information system
- Understand the frame work of Environmental Health information system
- Environmental health tracking network
- Geographical information system and its application in Environmental Health practice
- The concepts Environmental Health Information system its procedure and

structure

- Know the contemporary Environmental Health Information systems as used in morbidity surveys, diseases surveillance system, diseases register etc.

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3. 0 MAIN CONTENT

3.1 ENVIRONMENTAL HEALTH INFORMATION SYSTEM (EHIS)

3.2 CONCEPTS IN ENVIRONMENTAL HEALTH INFORMATION SYSTEM

3.2.1 ENVIRONMENT:

The term environment is widely used and has a broad range of definitions, meanings and interpretations. What does the term environment mean? In popular usage, for some people, the term environment means, simply, 'nature'. In other words, the natural landscape together with all of its non-human features, characteristics and process. To those people, the environment is often closely

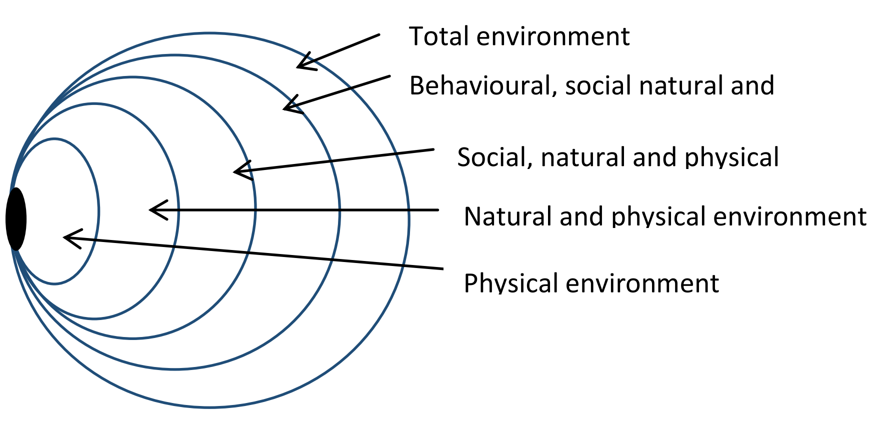


Figure 1: One way to represent environment from most inclusive to the most restrictive definition (Smith Carvalem and Kjellstrom, 1999).

For the purposes of environmental health, however, a more practical definition of the environment is needed, because environment health action generally tries to change only the natural and physical environment and related behaviours (e.g hand washing). Such interventions can rarely modify the social and cultural aspects of a community, which are usually independent of the environment (e.g cultural pressures on lifestyle, unemployment).

As a result, a more practical definition of the environment might be thatEnvironment is the complex of physical, chemical, and biotic biological factors (such as climate, soil and living things) that act upon an organization, or an ecological community and ultimately determine its form and survival, as well as the aggregate social and cultural conditions that influence the life of an individual, or community (Merriran Webster, 2019.)

According to Esri (2017), environmental health agencies at all levels of government and the partners that support them, example University, non-profit/non-governmental organization, information technology vendors and consultants, are increasingly using Geographic Information System (GIS) technology as assess and protect the health of the populations they serve, understand the impacts of the environment on human health and improve environmental health services delivery.

Environmental health organizations are interested in increasing their overall GIS capacity so they may enhance environmental health practices in both programmatic arrears, including air pollution, water, soil, toxics, waste, built environment, etc) and common business functions such as assessment, policy development and assurance (Esri, 2017).

3.2.2 ENVIRONMENTAL HEALTH

In layman's terms, environmental health (EH) is the health impact of the air we breathe, the water we drink, the homes we live in, the soil growing the food we eat, and the many other environmental exposures in our lives. The study of EH is not new. As early as 400 BC, Hippocrates said that one's health depends on the air one breathes, the water one drinks, and the environment in which one lives Hippocrates (Retrieved 2010). Another way of thinking of EH is that it is everything except genetics and personal behavior. The World Health Organization (WHO, 2009).

Environmental health comprises of those aspects of human health, including quality of life, that are determined by physical, chemical, biological, social, and psychosocial factors in the environment. It also refers to the theory and practice of assessing, correcting, controlling, and preventing those factors in the environment that can potentially affect adversely the health of present and future generations (WHO, 1993)

Environmental health addresses all the physical, chemical, and biological factors external to a person, and all the related factors impacting behaviours. It encompasses the assessment and control of those environmental factors that can potentially affect health. It is targeted towards preventing disease and creating health-supportive environments. This definition excludes behaviour not related to environment, as well as behaviour-related to the social and cultural environment, and genetics (WHO, 2009)

The impact of the environment on human health is substantial. According to WHO, environmental hazards are responsible for approximately 25 percent of the total burden of disease worldwide and nearly 35 percent in regions such as sub-Saharan Africa.3 WHO also states that as many as 13 million deaths can be prevented every year by making our environments healthier (WHO, 2009b). Below are examples of environment impacting human health:

- Air: During the last decade, epidemiological studies conducted worldwide have shown a consistent, increased risk for cardiovascular events, including heart and stroke deaths, in relation to short- and long-term exposure to present-day concentrations of pollution, especially particulate matter (AHA, 2010).
- Water: Arsenic in drinking water is a hazard to human health. The main source is arsenic-rich rocks, through which the water has filtered (WHO, 2010). Ironically, in some consequence of arsenic poisoning.
- Soil: Despite leaded paint and gasoline having been outlawed for many years in the United States (due to health concerns), lead in urban soil is a lingering source of lead poisoning in children (Frazer, 2008).

Due to the substantial impact of environment on human health, EH agencies and other EH organizations around the world have developed services and programs to protect the public's health. Government, academics, nongovernmental organizations (NGOs), and the private sector continue EH research initiatives. Some of these programs, services, and research initiatives are discussed later in this paper. Governmental EH agencies have primary responsibility for assessment, policy development, and assurance—the core functions of public health—but they share this responsibility with other sectors. Development of initiatives is under way to further define EH and articulate the services expected of EH agencies.

EH agencies and researchers face many challenges. When conducting environmental health studies, it is often difficult to have an accurate assessment of exposure. When making policy, it is often difficult to measure the impact of the environment on health outcomes. When ensuring the public's health through inspections (e.g., for wells, septic tanks, restaurants, hazardous waste sites, vector control) it is often difficult to prioritize due to the sheer number of sites under supervision. GIS technology is helping EH agencies and researchers address these challenges and many others.

3.2.3 Typical Programs and Services in Environmental Health

The delivery of EH services around the world varies in scope and depth due to differing environmental risks, available resources and funding schemes (e.g., general funds, fees, taxes, grants), and governmental structures (e.g., centralized or decentralized). Acknowledging such variations (which are beyond the scope of this paper), there is a surprising amount of commonality. Many subnational EH agencies engage in the following: (NACCHO, 2008).

- Food safety education
- Vector control (e.g., mosquitoes)
- Indoor air quality assurance
- Groundwater protection
- Surface water protection
- Noise pollution prevention
- Pollution prevention
- Hazardous waste disposal
- Land-use planning
- Collection of unused pharmaceuticals
- Housing Sanitation
- Occupational health and Safety
- Control of frontiers: air and sea ports and border crossing.

- Health education and promotion
- Protection of recreational environment
- Epidemiological investigation & Disease Control
- Air pollution prevention
- Radiation control
- Hazardous materials response
- Environmental Health Impact Assessment
- Research/ Collaborative efforts to study the effects of environmental hazards

Many subnational EH agencies conduct regulation, inspections, and/or licensing of

- Food service establishments
- Public swimming pools
- Septic systems
- Private drinking water
- Hotels/Motels
- Schools/Daycare centers
- Body art (tattoos, piercing)
- Children's camps
- Compliance with smoke-free ordinances
- Campgrounds/RVs
- Lead (in homes, soil, etc.)
- Mobile homes
- Solid waste haulers
- Solid waste disposal sites
- Tobacco retailers
- Food processing facilities
- Housing (inspections)
- Health-related facilities
- Public drinking water
- Cosmetology businesses
- Milk processing

Additional programmes and services include environmental health surveillance and epidemiology, exposure surveillance, laboratory services (e.g., testing for food-borne illnesses, lead), emergency response (e.g., chemical spills), and outdoor air pollution control. Many researchers and some agencies are focusing on how the built environment influences human health and are taking a more active role in land-use planning via public health impact statements and tools (Esri, 2011). Another recent development is Environmental Public Health Tracking (EPHT) (see next section). Many national and subnational agencies also provide technical assistance and funding to local agencies.

Given the variability in programs and services, the National Environmental Public Health Performance Standards (CDC, 2009, Esri, 2011) from the US Centers for Disease Control and Prevention (CDC) are an important benchmark for participating agencies to measure the capacity of their local environmental public health system or program. The assessment process encourages system or program partners to better coordinate and target their activities and is intended to provide a foundation for implementing performance improvement activities.

3.3.0 SYSTEM

A collection of components that work together to achieve a common objective.(Okareh, 2018).

3.3.1 INFORMATION SYSTEM

System that provides specific information support to the decision-making process at each level of an organization.

3.3.2 ENVIRONMENTAL HEALTH SYSTEM

Thisis defined as the system of all 'actors' (stakeholders), institutions, and resources that undertake "environmental health actions" – i.e. actions whose primary purpose is to promote, restore, or maintain the environmental factors that will affect the health of a population.

3.3.3 ENVIRONMENTAL HEALTH INFORMATION SYSTEM

"A system that provides specific environmental health information support to the decision-making process at each level of a health delivery organization."

3.4.0 ENVIRONMENTAL HEALTH MANAGEMENT INFORMATION SYSTEM:

An information system specially designed to assist in the management and planning of environmental health programs to enhance service delivery.

Environmental health science focuses on the interface between health and the environment, where interactions among people, the environment, and other living organisms affect the risk of toxicological and infectious disease.

3.4.1 Why Environmental Health Information System?

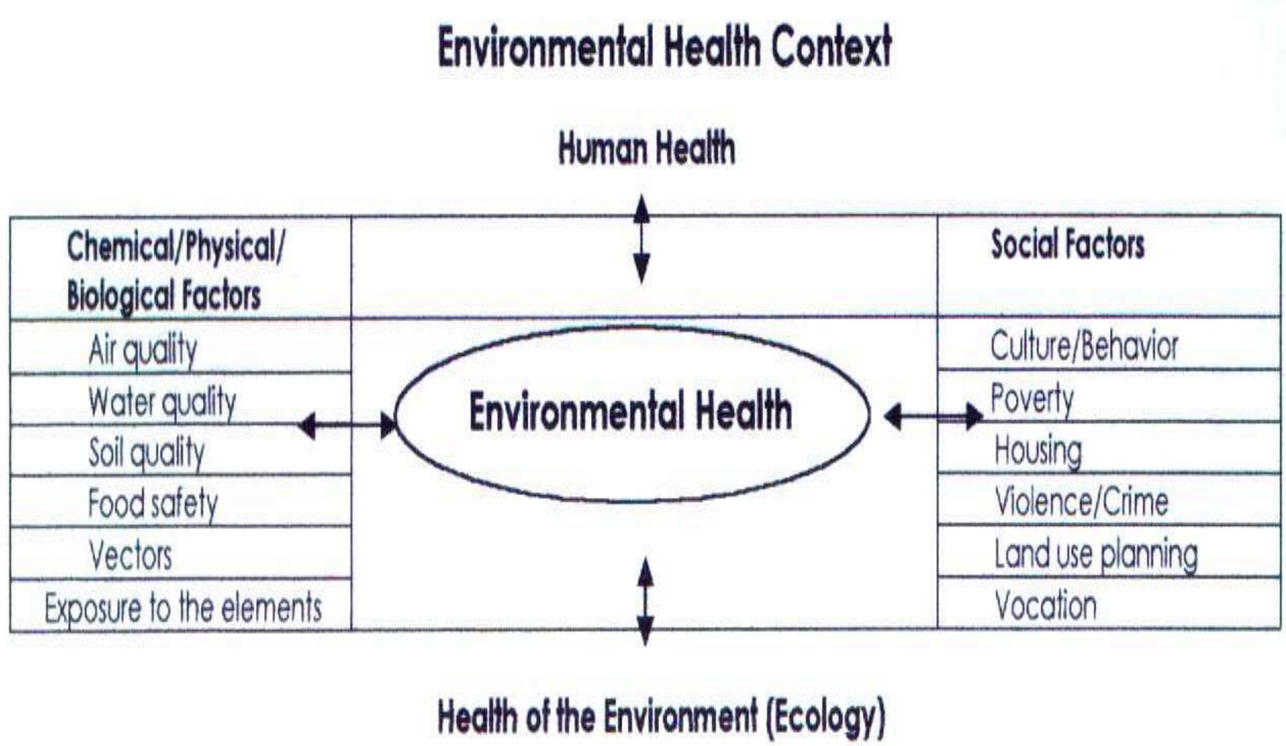
- Good management is a prerequisite for increasing the efficiency of environmental health services.

- Improved environmental health information system is clearly linked to good management and public health status.

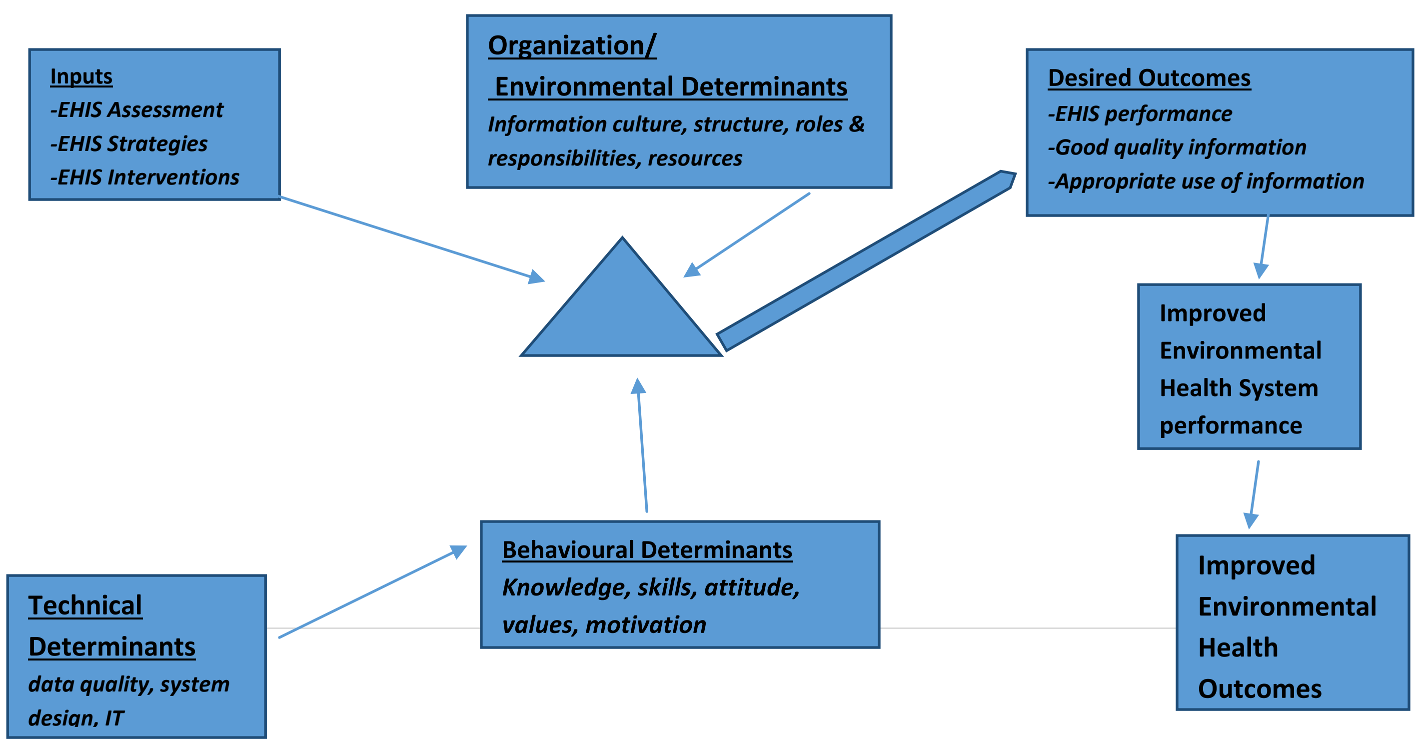
- Information is crucial at all management levels of the environmental health services from periphery to the center. It is required by policymakers, managers, environmental health service providers, community health workers.

Some modern information tools for data collection

- Geographical Information Tools (GIS)
- Photo voice
- Satellite imagery
- Drones
- Video voice data etc



Framework for environmental health information system (Adopted From Aqui,2009)



4.4.2 Framework for understanding Environmental Health Information System(EHIS) Performance

4.4.3 Environmental Health Tracking

Government agencies around the world collect data on human health including routine demographic and health surveys, vital records registries, and disease registries. Government agencies also collect data on environmental hazards including point sourcepollution, water quality, and air quality. Despite extensive data collection, there is very little consistent analysis of the links between the environmental exposures and health outcomes (such as asthma, birth defects, cancers, lead poisoning, and myocardial infarctions). In 2001, the Pew Environmental Health Commission issued a report entitled America's Environmental Health Gap: Why the Country Needs a Nationwide Health Tracking Network. That report recommended the creation of a "Nationwide Health Tracking Network for disease and exposures."11 The Pew report stimulated the formation of the Environmental Public Health Tracking Network, an initiative sponsored by CDC's National Center for Environmental Health. According to CDC, the goal of environmental public health tracking is to "protect communities by providing information to federal, state, and local agencies. These agencies, in turn, will use this information to plan, apply, and evaluate public health actions to prevent and control environmentally related diseases."12 Benefits of CDC's Environmental Public Health Tracking Network are listed in table 1 below.

3.4.4 Benefits of the Environmental Public Health Tracking Network (CDC, 2010)

1	Provide timely information to all users.
2	Integrate local, state, and national databases of environmental hazards, environmental exposures, and health effects.

3	Enable the ongoing analysis, integration, and interpretation of environmental hazards, exposure, and health effects data to control and prevent environmentally related health problems in the community.
4	Allow broad analysis across geographic and political boundaries.
5	Aid research by providing easier access to environmental and public health data (e.g., the Institutional Review Board and secondary data look-up information).
6	Promote interoperable systems via compliance with standards.
7	Identify gaps in environmental and public health data systems through network development and use.
8	Increase environmental public health capacity at state and local levels.
9	Increase collaboration and partnerships among traditional health and environmentally focused entities at the federal, state, and local levels via network development and use.
10	Provide a means to enhance and improve data (e.g., geocoding).
11	Contribute to the Public Health Information Network (PHIN) by helping define standards to better integrate environmental and public health data.
12	Provide a secure, reliable, and expandable means to link environmental and health data.

The United States is neither the only nor the first nation to undertake such an initiative. Other nations have tracking-like initiatives under way, and others are exploring the feasibility of tracking. Beale et al conclude, "The scope and importance of such schemes should not be underestimated because they not only provide sources for suitable data and tools for epidemiology but also lead to a more specific, integrated, and standard approach to data collection and analysis."(Beale, 2008)

Governmental health agencies and private foundations fund a substantial portfolio of extramural environmental health research around the world through research centers and institutes at universities as well as awards to individual investigators. Governmental agencies also conduct substantial intramural research. Researchers investigate how environmental agents cause or exacerbate a variety of human diseases and disorders. More recently, there has been an emphasis on understanding the impact of the built environment on public health. Some research initiatives are linked to environmental public health practice and environmental public health tracking networks.

3.5 .0 GEOGRAPHICAL INFORMATION SYSTEM (GIS)

GIS is an integrated collection of computer software and data used to view and manage information connected with specific locations, analyze spatial relationships, and model spatial processes (Wade and Somer, 2006). The majority of data in public health has a spatial (location) component, to which GIS adds a powerful graphical and analytic dimension by bringing together the fundamental epidemiological triad of person, time, and the often-neglected place (PHAC, 2016).

GIS technology integrates common database operations, such as query and statistical analysis, with the unique visualization and geographic analysis benefits offered by maps. These abilities distinguish GIS from other information systems and make it valuable to environmental health organizations for explaining events, predicting outcomes, and planning strategies. In this sense, GIS is much more than a computer map; it is a decision support system that integrates spatially referenced data and statistical analyses to address environmental health problems (Shoultz, 2005). GIS is a powerful tool for examining population-level effects of exposures as reflected in the geographic and spatial distribution of populations. Mapmaking and geographic analysis are not new, but a GIS performs these tasks better and faster than the old manual methods. Before GIS technology, only a few people had the skills necessary to use geographic information to help with decision making and problem solving.

The major EH challenges in the world today all have a geographic component. GIS organizes geographic data so that a person reading a map can select data necessary for a specific project or task. A thematic map has a table of contents that allows the reader to add layers of information to a basemap of real-world locations. With an ability to combine a variety of datasets in an infinite number of ways, GIS is a useful tool for nearly every field of knowledge within EH.

A good GIS program is able to process geographic data from a variety of sources and integrate it into a map project. Many countries have an abundance of geographic data for analysis, and governments often make GIS datasets publicly available. Map file databases often come included with GIS packages; others can be obtained from both commercial vendors and government agencies. Some data is gathered in the field by global positioning units that attach a location coordinate (latitude and longitude) to a feature such as a health facility or a storage tank. The wide availability of rugged hardware devices (tablet PCs, ruggedized PDAs, etc.) combined with recent advances in the mobile components of server GIS technology make GIS even more useful for EH agencies.

GIS maps are interactive. On the computer screen, map users can scan a GIS map in any direction, zoom in or out, and change the nature of the information contained in the map. They can choose whether to see the roads, how many roads to see, and how roads should be depicted. Then they can select what other items they wish to view alongside these roads such as hazardous waste sites, vegetation, or population density. Some GIS programs are designed to perform sophisticated calculations for tracking storms or predicting erosion patterns. GIS applications can be embedded into common activities such as verifying an address.

Many people associate specialized software and powerful computers with the idea of geographic information systems. A GIS actually has five equally important components: people, hardware, software, data, and applications. GIS technology is of limited value without the people who manage and use the system, ranging from technical specialists to spatial analysts to casual users. Possibly the most important and costly component of a GIS is the data. Geographic data and related tabular data can be collected in-house or purchased from a commercial data provider. A GIS will integrate spatial data with other data resources and can use a database management system (DBMS), used by most organizations to organize and maintain their data, to manage spatial data. A successful GIS operates according to the data needs, models, and operating practices unique to each organization. Applications are designed to enhance and automate everyday procedures or produce informative statistics on the state of EH or the results of a given program. There are many extensions, plug-ins, and other enhancements to GIS software that are relevant to EH organizations. Examples include Geostatistical Analyst, Spatial Analyst (ModelBuilder™), and the Rapid Inquiry Facility (RIF) tool.

Table 2: Relevance of GIS to Essential Environmental Public Health Services

ESSENTIAL SERVICE	GIS RELEVANCE
1. Monitor environmental and health status to identify and solve community EH problems.	GIS is a tool for assessing EH, analyzing trends, and communicating EH problems and risks to the public through static or interactive maps. GIS also has many functions helpful for exposure assessment, data aggregation, data management, and other linkages. A good example of using GIS for this essential service is the work of EPHT.
2. Diagnose and investigate EH problems and health hazards in the community.	GIS supports EH surveillance systems with more efficient data collection methodologies, better understanding of disease transmission dynamics, and a framework for outbreak investigation and response. As mentioned above, there is universal consensus that a GIS can be a useful aid at the beginning of an environmental epidemiology or risk assessment study. GIS also facilitates targeting of prevention
3. Inform, educate, and empower people about EH issues.	GIS facilities targeting health communication geographically and demographically. Desktop GIS and web-based portals such as ToxMAPand South Carolina Community Assessment Network educate and empower people to understand EH issues.

4. Mobilize community partnerships and actions to identify and solve EH problems.	Maps are great tools for community engagement. Desktop GIS and web-based portals such as the ones listed above help mobilize community partnerships. Another example is the "rat information portal" in New York City. GIS provides a framework for analyzing and solving many other EH problems (e.g., lead poisoning mitigation and prevention and integrated vector control to prevent malaria or dengue).
5. Develop policies and plans that support individual and community EH efforts	The quote "Documenting need is not enough; documenting *where* there is need is critical to intervention strategies"28 holds true for EH practice. GIS has helped policy makers understand the scope of environmental health emergencies, the built environment, and the "zone of influence" of mobile sources of air pollution. GIS also plays a central role in public health impact assessments
6. Enforce laws and regulations that protect EH and ensure safety.	GIS-based methods help measure compliance with local laws (e.g., environmental setback regulations) and spatial advertising restrictions in local and national laws (e.g., tobacco advertising near schools). GIS-based methods are also utilized to geocode facilities and sites under regulation, route the inspectors who regulate them, and track progress. GIS-based models allow planners to consider the safety of citizens.
7. Link people to needed personal EH service and ensure the provision of health care when otherwise unavailable	GIS helps identify underserved populations and barriers to service and coordinate service delivery among multiple agencies. GIS-enabled services locators help citizens understand what services are available in their area and which offices are responsible.
8. Ensure competent EH and personal health care workforces.	Agencies and researchers have utilized GIS to assess workforce gaps in many different professions, including the EH workforce in California Geospatial analysis can characterize the pattern of deployment of the EH workforce and (with statistical modeling) analyze factors associated with the deployment pattern.

9. Evaluate effectiveness, accessibility, and quality of personal and population-based EH services.	GIS provides a framework for monitoring and evaluating programs and services. One of the most popular applications of GIS in health and human services is analyzing access to services.
10. Search for new insights and innovative solutions to EH problems.	GIS enables testing and considering options in both temporal and spatial contexts. Geospatial accuracy provides EH professionals and research partners with a more specific baseline for implementing and evaluating EH interventions and programs. GIS helps researchers aggregate data and understand complex, multidimensional relationships between pollution and disease.

3.5.1Understanding Geography as a Common Frame of Reference

Modernizing EH information systems to facilitate more efficient assessment, policy development, and assurance requires geographically referenced information. The science of geography recognizes that almost everything that exists can be expressed in terms of its location and therefore has established a standard framework of spatial coordinates to communicate and relate the placement of people, things, and events, wherever that may be. Therefore, geography provides a spatial baseline that is used for storing, analyzing, and communicating most types of data. Eventually, geography supplies structurally coherent common ground for decision support mechanisms. EH agencies stand to benefit profoundly from enhanced application of geographic intelligence through GIS. Existing GIS within Health and Human Service Agencies

3.5.2Existing GIS within Health and Human Service Agencies

Public health departments around the world have embraced GIS as a tool for collecting and analyzing data, evaluating health programs, and communicating results (internally, to policy makers, and to the public). WHO, the European Centre for Disease Prevention and Control (ECDC), CDC, US Environmental Protection Agency (EPA), all 50 US state

health departments, hundreds of US local health departments (LHDs), and the majority of accredited schools of public health in the United States all use Esri GIS software.

Public health organizations use GIS on a daily basis to analyze the spread of infectious and chronic diseases, promote and encourage healthy behaviors, protect the public against environmental hazards (as discussed throughout this paper), prevent injuries (e.g., analyzing traffic injuries by location), respond to disasters and assist communities in recovery (e.g., situational awareness, identifying vulnerable populations), and ensure the quality and accessibility of health services as well as many other programs and services.

In the United States, GIS and geocoding are also part of HealthyPeople 2020 (National Health Goals for the United States) Enterprise GIS and the National Public Heath Performance Standards Program. Recently, the number of presentations at the American Public Health Association (APHA) annual meeting referencing use of GIS has increased substantially.18 This is indicative of the trend of increasing utilization of GIS in public health practice.

3.5.3Enterprise GIS

GIS has been embraced by the IT community and has become a strategic component of information technologies incorporated into the central systems of many enterprises. The existing deployments of Esri desktop, server, and mobile GIS technologies referenced above, together with increasing geocoding capacities spurred by HealthyPeople 2020, EPHT, and other initiatives, present many opportunities for shared business capabilities between EH agencies and sister agencies.

In many health agencies, GIS starts out as a stand-alone analytic tool for environmental health investigation, health planning, or epidemiologic research. But over time, GIS spans the entire HHS enterprise, serving multiple divisions, programs, and people from the computer desktop to web applications to mobile phones and PDAs.

Over the last few years, many governmental agencies have developed web services that can be consumed by sister agencies. In some cases, environmental health agencies are hosting and publishing such services. These include map, geocoding, and other analytic services. The geocoding services facilitate real-time geocoding of vital events such as births and deaths. An enterprise-wide geocoding service could be leveraged by EH information systems as a shared business capability.

Recognizing the growing importance of GIS, state chief information officers (CIOs) in the United States placed GIS on their Top Ten Priority Technologies list for 2008. The National States Geographic Information Council (NSGIC) (www.nsgic.org) has also been active in this area. NSGIC is committed to efficient and effective government through the prudent adoption of geospatial information technologies. The most current NSGIC survey of states' GIS initiatives is available at www.gisinventory.net/summaries.

3.5.4 Geographically Enabling Environmental Health

There are many references supporting the notion that EH practice and research should be geographically enabled with GIS model practices. Over a decade ago, EH professionals came to universal consensus that a GIS can be a useful aid at the beginning of an environmental epidemiology or risk assessment study.19 More recently, Miranda et al noted, "Many GIS-based projects have been successful in supporting public and environmental health practice, including those investigating toxic exposure, vector-borne disease, health information access, and the built environment." She and her team had engaged local health departments in a capacity-building project. When evaluating the project, "staff and directors alike viewed improved service delivery, as well as time and cost efficiency, as significant outcomes."

Many leading public health organizations have endorsed the use of GIS in public health practice and research. CDC says, "GIS plays an important part in health promotion and protection." WHO says GIS

- Is "highly suitable for analyzing epidemiological data, revealing trends and interrelationships that would be more difficult to discover in tabular format"
- "Allows policy makers to easily visualize problems in relation to existing health and social services and the natural environment and so more effectively target resources"
- Is an "ideal platform for the convergence of disease-specific information and their analyses in relation to population settlements, surrounding social and health services and the natural environment"

The draft Environmental Public Health Performance Standards in the United States specifically reference "utilization of appropriate methods and technology, such as geographic information systems, to interpret and communicate data to diverse audiences."24 The draft standards include a specific indicator (1.3) regarding the identification and use of appropriate data collection, storage, analysis, and communication tools. That indicator asks whether the jurisdiction has identified and used appropriate tools for collecting, storing, analyzing, and presenting data (e.g., GIS). Such references are by no means limited to the United States. For example, the WHO Regional Dengue Plan for 2008–201525 includes a string of GIS-related items under Expected Goal 10. In the WHO Dengue Plan, ministries of health were encouraged to conduct basic GIS workshops in 2009–2010 and to include GIS as part of their integrated vector management.

GIS offers many practical opportunities for improving the efficiency of existing business processes by leveraging the power of place. These opportunities are described more fully in the following section.

3.5.5Environmental Health Business Processes and GIS

GIS provides tools and capabilities for performing a wide array of activities associated with geographic and spatially referenced information. Associating data with location optimizes analysis, visualization, and reporting/communication of information, thus maximizing the value of the data. Below are examples of enhancing EH business processes (organized by three core functions) with GIS.

- Assessment. In the field, using GIS/GPS capabilities facilitates better navigation (e.g., finding locations) as well as the ability to geocode precisely the point sources of EH risks and pollution through GPS. Precisely measured locations and distances enable not only immediate decision support but also a higher degree of precision in future analyses. Once EH data is geographically enabled, GIS provides a platform for making assessment data more actionable through multilayer data analysis (e.g., determining populations within specific distance buffers for emergency notifications) and more advanced spatial and statistical analyses. Increasingly, geocoding, buffering, and kriging are utilized in methods assigning exposure in EH studies. EH professionals digitize data (e.g., district boundaries), geocode residential or business addresses, and link to a variety of data (e.g., satellite, aerial photography, third-party, and census data) for exploratory spatial data analysis and prefieldwork. GIS also empowers EH professionals to prepare for field visits while still in the office. They use satellite photography, soil layers, and various geoprocessing tools to predetermine best locations for septic tanks. GIS also helps EH organizations conduct specific surveillance and meet tracking requirements. During emergencies, GIS quickly calculates the depths of floods and numbers of affected homes and can speed up reimbursement from emergency management agencies. Increasingly, EH professionals are utilizing spatial statistics tools and GIS analysis to proactively identify significant community health problems.

- Policy development. EH organizations use GIS-based models to determine the impacts of proposed EH policies. GIS-based site location models help determine the best locations for hazardous waste and the safest routes to get it from point A to point B. Such analyses may incorporate multiple layers (e.g., population density, transportation networks). Increasing GIS synergies with common document formats, such as PDF reports, enable the publishing of GIS layers when communicating policy and administrative decisions to partner agencies, regulated entities, and other constituents. Business intelligence software is increasingly integrated with GIS, facilitating enhanced analysis, visualization, and reporting options.

- Assurance. EH organizations use GIS to increase efficiency. GIS facilitates targeting vector control efforts. Agencies use GIS tools and methodologies to measure compliance with specific legislation (e.g., specific types of industry/businesses being prohibited from operating within certain distances of rivers or other environmentally sensitive areas or restrictions regarding advertising tobacco within certain distances of schools). GIS helps determine the prudent use of staff in implementing EH inspections (calculating location-based workload assessment, finding efficient routes, and determining which vehicle should serve each location in the best stop sequence). Geocoding and address management help reduce undeliverable mail and save time and money spent correcting wrong addresses.

Recently, EH professionals have articulated and mapped their business processes and objectives to the Public Health Essential Services framework. Table 2 provides an overview of selected EH essential services26 and GIS.

3.5.6PROGRAMMATIC AREAS AND GIS

There are numerous examples of GIS supporting specific programmatic areas in EH, in many cases to partially or fully meet program mandates. The following subject headings are taken from HealthyPeople 2020 Environmental Health Objectives.

3.5. 7Outdoor Air Quality

Examples include

- Improving the accuracy of air pollution health impact assessments with GIS
- Examining residential proximity to heavy-traffic roadways and associated adverse health outcomes
- Estimating at what distances the impact of direct traffic emissions on ambient particulate matter concentrations are significant
- Developing semiautomated GIS approaches to estimation of daily air pollution concentrations (e.g., using kriging)
- Using land use-based regression (LUR) and GIS-based estimation to estimate exposure to pollutants (over the traditional area-average approach)
- Using GIS to develop web-based carpooling programs

3.5.8 Water Quality

Examples include

- Using GIS to track violations, health advisories, boil water orders, and reported illnesses that may be related to drinking water
- Using GIS-based spatial analysis and statistical analysis to determine clustering of cholera
- Using Web-based maps to display oil spill information, coliform levels for beaches, well-water quality data, etc.
- Spatially locating residences and pipes (e.g., vinyl lined)

- Monitoring naturally occurring contaminants in public drinking water (such as arsenic and nitrates)
- Developing GIS data models to determine arsenic contamination (safe and vulnerable areas) as well as where to focus intervention campaigns
- Examining relationships between arsenic levels in water and various cancers
- Assigning cases to corresponding water supply zones using point in polygon techniques
- Producing attack rate maps based on water districts
- Producing color-coded, GIS-based consumption advisory maps providing location-specific information on the amount of methylmercury in fish

3.5.9 Toxics and Waste

Examples include

- Applying thematic mapping and analysis (e.g., buffering) to identify locations where potentially noxious land uses may be having a disparate adverse impact on minority and low-income populations
- Achieving community buy-in for the enactment of public health regulations
- Using mobile GIS/GPS technologies to conduct surveillance (exposure assessment) for radiation, asbestos particles, radio frequency exposure, etc.)

- Finding associations between maternal residence near agricultural pesticide applications and autism spectrum disorders among children
- Modeling plumes (smoke, dust, asbestos, PCBs, and other pollutants)
- Comparing mapped reports of respiratory problems with plume locations
- Testing the efficacy of aerial spraying of mosquito adulticide in reducing incidence of West Nile virus
- Using GIS-based methods to recruit participants for prospective pesticide exposure studies, thereby increasing efficiency and enhancing accuracy

3.6.0 Healthy Homes and Healthy Communities

Examples include

- Assessing the size and dimensions of green spaces and their respective distances from the population of potential users
- Using GIS to expand policy makers' awareness of the proximity of environmental hazards to schools
- Examining environmental conditions (criteria pollutants, pollens, mold spores, and pyrethrin pesticides) and respiratory problems (especially asthma)
- Using GIS in asthma surveillance, such as the relationship between asthma hospitalizations by ZIP Code™ and environmental factors
- Using GIS portals to track rats and rat complaints
- Using exploratory spatial data analysis to assess the extent of lead poisoning clustering and examine the geographic distribution of lead poisoning rates throughout a jurisdiction
- Examining the geographic distribution of important lead poisoning risk factors and prioritizing lead poisoning prevention programs (e.g., through GIS data linkages to cadastral records)
- Detecting radon hot spots and producing national radon risk maps

- Using GIS in disaster preparedness drills (mass vaccination, stockpile location and logistics, geographic emergency notification)
- Using GIS–CAD integration and robots to monitor indoor environments

3.6.1 Infrastructure and Surveillance

Examples include

- GIS-based models to estimate exposure to pesticides
- Environmental Public Health Tracking portals
- West Nile virus surveillance systems
- GIS-based well inspection systems
- Spatiotemporal analysis of the relationship between vector-borne disease dissemination and environmental variables
- Other GIS-based inspection systems

3.6.2 Global Environmental Health

Examples include

- Mapping the burden of diseases
- Investigating cholera epidemics
- Detecting regions of higher incidence of diarrhea and other water-borne diseases
- Measuring distances from households to water sources
- Analyzing travel time for obtaining clean water
- Analyzing the spatial distribution of standard morbidity rates per area

4.0 CONCLUSION

You have learned the learn the concept of Environmental Health Information system , frame work for Environmental information system, modern information tool, data collection techniques and environmental health tracking. Learned also the relevance of Environmental Health information system in Environmental Health services. Geo informatics include remote sensing and global navigation satellite system etc

5.0 SUMMARY

Environmental Health Information System

Good management is a prerequisite for increasing the efficiency of environmental health services. Improved environmental health information system is clearly linked to good management and public health status. Information is crucial at all management levels of the environmental health services from periphery to the center.

Some modern information tools for data collection

- Geographical Information Tools (GIS)
- Photo voice
- Satellite imagery
- Drones
- Video voice data etc

GIS has been embraced by the IT community and has become a strategic component of information technologies incorporated into the central systems of many enterprises. The existing deployments of Esri desktop, server, and mobile GIS technologies referenced above, together with increasing geocoding capacities spurred by HealthyPeople 2020, EPHT, and other initiatives, present many opportunities for shared business capabilities between EH agencies and sister agencies.

6.0 TUTOR-MARKED ASSIGNMENT

Define the terms Environment. Environmental Health and Environmental Health information system

Explain the frame -work of Environmental Health information system

Identify the Environmental health- tracking network system

Explain Geographical information system and its application in Environmental Health practice

Enumerate Environmental Health Information system and its procedure and structure

contemporary Environmental Health Information systems as used in morbidity surveys, diseases surveillance system, diseases register etc.

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UNIT 2: COMPUTER SIMULATION

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1.0 INTRODUCTION

Computer simulation is the reproduction of the behavior of a system using a computer to simulate the outcomes of a mathematical model associated with said system

Computer simulations are used in a wide variety of practical contexts, such as:

- analysis of air pollutant dispersion using atmospheric dispersion modeling
- design of complex systems such as aircraft and also logistics systems.
- design of noise barriers to effect roadway noise mitigation
- modeling of application performance(Wescott, 2013)
- flight simulators to train pilots
- weather forecasting
- forecasting of risk
- simulation of electrical circuits
- Power system simulation
- simulation of other computers is emulation.
- forecasting of prices on financial markets (for example Adaptive Modeler)
- behavior of structures (such as buildings and industrial parts) under stress and other conditions
- design of industrial processes, such as chemical processing plants

2.0 OBJECTIVES

By the end of this unit, you will be able to:

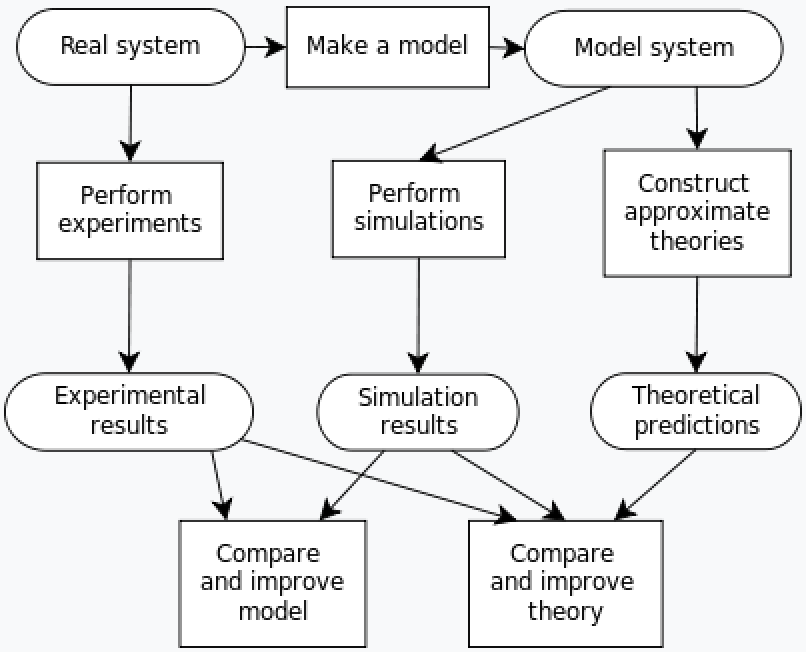
i. Appreciate the computer simulation and life-table techniques
ii. Know how to manage Medical and Health data- base
iii. Understand the applications of intranate, internate and internate
iv. Understand the use of Electronic Library system
v. Appreciate the application of Geo- information technology in Environmental health practice
vi. Appreciate geo- informatics globalization and teleconferencing

3.0 COMPUTER SIMULATION

Computer simulation is the reproduction of the behavior of a system using a computer to simulate the outcomes of a mathematical model associated with said system. Since they allow to check the reliability of chosen mathematical models, computer simulations have become a useful tool for the mathematical modeling of many natural systems in physics (computational physics), astrophysics, climatology, chemistry, biology and manufacturing, human systems in economics, psychology, social science, health care and engineering. Simulation of a system is represented as the running of the system's model. It can be used to explore and gain new insights into new technology and to estimate the performance of systems too complex for analytical solutions.(Shogatz, 2007)

Computer simulations are realized by running computer programs that can be either small, running almost instantly on small devices, or large-scale programs that run for hours or days on network-based groups of computers. The scale of events being simulated by computer simulations has far exceeded anything possible (or perhaps even imaginable) using traditional paper-and-pencil mathematical modeling. Over 10 years ago, a desert-battle simulation of one force invading another involved the modeling of 66,239 tanks, trucks and other vehicles on simulated terrain around Kuwait, using multiple supercomputers in the DoD High Performance Computer Modernization Program (Website) Other examples include a 1-billion-atom model of material deformation (Website) a 2.64-million-atom model of the complex protein-producing organelle of all living organisms, the ribosome, in 2005 (Ambrosiano, 2005) a complete simulation of the life cycle of Mycoplasma genitalium in 2012; and the Blue Brain project at EPFL (Switzerland), begun in May 2005 to create the first computer simulation of the entire human brain, right down to the molecular level.[5]

Because of the computational cost of simulation, computer experiments are used to perform inference such as uncertainty quantification. (Santner, 2003)



Process of building a computer model, and the interplay between experiment, simulation, and theory.

3.0.1 Data Preparation

The external data requirements of simulations and models vary widely. For some, the input might be just a few numbers (for example, simulation of a waveform of AC electricity on a wire), while others might require terabytes of information (such as weather and climate models).

Input sources also vary widely:

- Sensors and other physical devices connected to the model;
- Control surfaces used to direct the progress of the simulation in some way;
- Current or historical data entered by hand;
- Values extracted as a by-product from other processes;
- Values output for the purpose by other simulations, models, or processes.

Lastly, the time at which data is available varies:

- "invariant" data is often built into the model code, either because the value is truly invariant (e.g., the value of π) or because the designers consider the value to be invariant for all cases of interest;
- data can be entered into the simulation when it starts up, for example by reading one or more files, or by reading data from a preprocessor;
- data can be provided during the simulation run, for example by a sensor network.

Because of this variety, and because diverse simulation systems have many common elements, there are a large number of specialized simulation languages. The best-known may be Simula (sometimes called Simula-67, after the year 1967 when it was proposed). There are now many others.

Systems that accept data from external sources must be very careful in knowing what they are receiving. While it is easy for computers to read in values from text or binary files, what is much harder is knowing what the accuracy (compared to measurement resolution and precision) of the values are. Often they are expressed as "error bars", a minimum and maximum deviation from the value range within which the true value (is expected to) lie. Because digital computer mathematics is not perfect, rounding and truncation errors multiply this error, so it is useful to perform an "error analysis (Taylor, 2015) to confirm that values output by the simulation will still be usefully accurate.

Even small errors in the original data can accumulate into substantial error later in the simulation. While all computer analysis is subject to the "GIGO" (garbage in, garbage out) restriction, this is especially true of digital simulation. Indeed, observation of this inherent, cumulative error in digital systems was the main catalyst for the development of chaos theory.

Types

Computer models can be classified according to several independent pairs of attributes, including:

- Stochastic or deterministic (and as a special case of deterministic, chaotic) – see external links below for examples of stochastic vs. deterministic simulations
- Steady-state or dynamic
- Continuous or discrete (and as an important special case of discrete, discrete event or DE models)
- Dynamic system simulation, e.g. electric systems, hydraulic systems or multi-body mechanical systems (described primarely by DAE:s) or dynamics simulation of field problems, e.g. CFD of FEM simulations (described by PDE:s).
- Local or distributed.

Another way of categorizing models is to look at the underlying data structures. For time-stepped simulations, there are two main classes:

- Simulations which store their data in regular grids and require only next-neighbor access are called stencil codes. Many CFD applications belong to this category.
- If the underlying graph is not a regular grid, the model may belong to the meshfree method class.

Equations define the relationships between elements of the modeled system and attempt to find a state in which the system is in equilibrium. Such models are often used in simulating physical systems, as a simpler modeling case before dynamic simulation is attempted.

- Dynamic simulations model changes in a system in response to (usually changing) input signals.
- *Stochastic* models use *random number generators* to model chance or random events;
- A *discrete event simulation* (DES) manages events in time. Most computer, logic-test and fault-tree simulations are of this type. In this type of simulation, the simulator maintains a queue of events sorted by the simulated time they should occur. The simulator reads the queue and triggers new events as each event is

processed. It is not important to execute the simulation in real time. It is often more important to be able to access the data produced by the simulation and to discover logic defects in the design or the sequence of events.

- A *continuous dynamic simulation* performs numerical solution of differential-algebraic equations or differential equations(either partial or ordinary). Periodically, the simulation program solves all the equations and uses the numbers to change the state and output of the simulation. Applications include flight simulators, construction and management simulation games, chemical process modeling, and simulations of electrical circuits. Originally, these kinds of simulations were actually implemented on analog computers, where the differential equations could be represented directly by various electrical components such as op-amps. By the late 1980s, however, most "analog" simulations were run on conventional digital computers that emulate the behavior of an analog computer.
- A special type of discrete simulation that does not rely on a model with an underlying equation, but can nonetheless be represented formally, is agent-based simulation. In agent-based simulation, the individual entities (such as molecules, cells, trees or consumers) in the model are represented directly (rather than by their density or concentration) and possess an internal state and set of behaviors or rules that determine how the agent's state is updated from one time-step to the next.
- Distributed models run on a network of interconnected computers, possibly through the Internet. Simulations dispersed across multiple host computers like this are often referred to as "distributed simulations". There are several standards for distributed simulation, including Aggregate Level Simulation Protocol (ALSP), Distributed Interactive Simulation (DIS), the High Level Architecture (simulation) (HLA) and the Test and Training Enabling Architecture (TENA)

Generic examples of types of computer simulations in science, which are derived from an underlying mathematical description:

- a numerical simulation of differential equations that cannot be solved analytically, theories that involve continuous systems such as phenomena in physical cosmology, fluid dynamics (e.g., climate models, roadway noisemodels, roadway air dispersion models), continuum mechanics and chemical kinetics fall into this category.
- a stochastic simulation, typically used for discrete systems where events occur probabilistically and which cannot be described directly with differential equations (this is a *discrete* simulation in the above sense). Phenomena in this category include genetic drift, biochemical[8] or gene regulatory networks with small numbers of molecules. (see also: Monte Carlo method).
- multiparticle simulation of the response of nanomaterials at multiple scales to an applied force for the purpose of modeling their thermoelastic and thermodynamic properties. Techniques used for such simulations are Molecular dynamics, Molecular mechanics, Monte Carlo method, and Multiscale Green's function.

Specific examples of computer simulations follow:

- statistical simulations based upon an agglomeration of a large number of input profiles, such as the forecasting of equilibrium temperature of receiving waters, allowing the gamut of meteorological data to be input for a specific locale. This technique was developed for thermal pollution forecasting.
- agent based simulation has been used effectively in ecology, where it is often called "individual based modeling" and is used in situations for which individual variability in the agents cannot be neglected, such as population dynamics of salmon and trout (most purely mathematical models assume all trout behave identically).

- time stepped dynamic model. In hydrology there are several such hydrology transport models such as the SWMM and DSSAM Models developed by the U.S. Environmental Protection Agency for river water quality forecasting.
- computer simulations have also been used to formally model theories of human cognition and performance, e.g., ACT-R.
- computer simulation using molecular modeling for drug discovery. (Atenasov, 2015)
- computer simulation to model viral infection in mammalian cells. (Gupta & Rawlings, 2014)
- computer simulation for studying the selective sensitivity of bonds by mechanochemistry during grinding of organic molecules.(Mizukami, 2011).
- Computational fluid dynamics simulations are used to simulate the behaviour of flowing air, water and other fluids. One-, two- and three-dimensional models are used. A one-dimensional model might simulate the effects of water hammer in a pipe. A two-dimensional model might be used to simulate the drag forces on the cross-section of an aeroplane wing. A three-dimensional simulation might estimate the heating and cooling requirements of a large building.
- An understanding of statistical thermodynamic molecular theory is fundamental to the appreciation of molecular solutions. Development of the Potential Distribution Theorem (PDT) allows this complex subject to be simplified to down-to-earth presentations of molecular theory.

Notable, and sometimes controversial, computer simulations used in science include: Donella Meadows' World3 used in the *Limits to Growth*, James Lovelock's Daisyworld and Thomas Ray's Tierra.

In social sciences, computer simulation is an integral component of the five angles of analysis fostered by the data percolation methodology, (Mesly, 2015) which also includes qualitative and quantitative methods, reviews of the literature (including scholarly), and interviews with experts, and which forms an extension of data triangulation.

3.0.4 Simulation environments for physics and engineering

Graphical environments to design simulations have been developed. Special care was taken to handle events (situations in which the simulation equations are not valid and have to be changed). The open project Open Source Physics was started to develop reusable libraries for simulations in Java, together with Easy Java Simulations, a complete graphical environment that generates code based on these libraries.

3.0.2 Simulation environments for linguistics

Taiwanese Tone Group Parser (Chang, 2017)is a simulator of Taiwanese tone sandhi acquisition. In practical, the method using linguistic theory to implement the Taiwanese tone group parser is a way to apply knowledge engineering technique to build the experiment environment of computer simulation for language acquisition. A work-in-process version of artificial tone group parser that includes a knowledge base and an executable program file for Microsoft Windows system (XP/Win7) can be download for evaluation.

3.0.3 Computer simulation in practical contexts

Computer simulations are used in a wide variety of practical contexts, such as:

- analysis of air pollutant dispersion using atmospheric dispersion modeling
- design of complex systems such as aircraft and also logistics systems.
- design of noise barriers to effect roadway noise mitigation
- modeling of application performance(Wescott, 2013)
- flight simulators to train pilots
- weather forecasting
- forecasting of risk
- simulation of electrical circuits

- Power system simulation
- simulation of other computers is emulation.
- forecasting of prices on financial markets (for example Adaptive Modeler)
- behavior of structures (such as buildings and industrial parts) under stress and other conditions
- design of industrial processes, such as chemical processing plants
- strategic management and organizational studies
- reservoir simulation for the petroleum engineering to model the subsurface reservoir
- process engineering simulation tools.
- robot simulators for the design of robots and robot control algorithms
- urban simulation models that simulate dynamic patterns of urban development and responses to urban land use and transportation policies. See a more detailed article on Urban Environment Simulation.
- traffic engineering to plan or redesign parts of the street network from single junctions over cities to a national highway network to transportation system planning, design and operations. See a more detailed article on Simulation in Transportation.
- modeling car crashes to test safety mechanisms in new vehicle models.
- crop-soil systems in agriculture, via dedicated software frameworks (e.g. BioMA, OMS3, APSIM)

The reliability and the trust people put in computer simulations depends on the validity of the simulation model, therefore verification and validation are of crucial importance in the development of computer simulations. Another important aspect of computer simulations is that of reproducibility of the results, meaning that a simulation model should not provide a different answer for each execution. Although this might seem obvious, this is a special point of attention in stochastic simulations, where random numbers should actually be semi-random numbers. An exception to reproducibility are human-in-the-loop simulations such as flight simulations and computer games. Here a human is part of the simulation and thus influences the outcome in a way that is hard, if not impossible, to reproduce exactly.

Vehicle manufacturers make use of computer simulation to test safety features in new designs. By building a copy of the car in a physics simulation environment, they can save the hundreds of thousands of dollars that would otherwise be required to build and test a unique prototype. Engineers can step through the simulation milliseconds at a time to determine the exact stresses being put upon each section of the prototype.(Baase,2007)

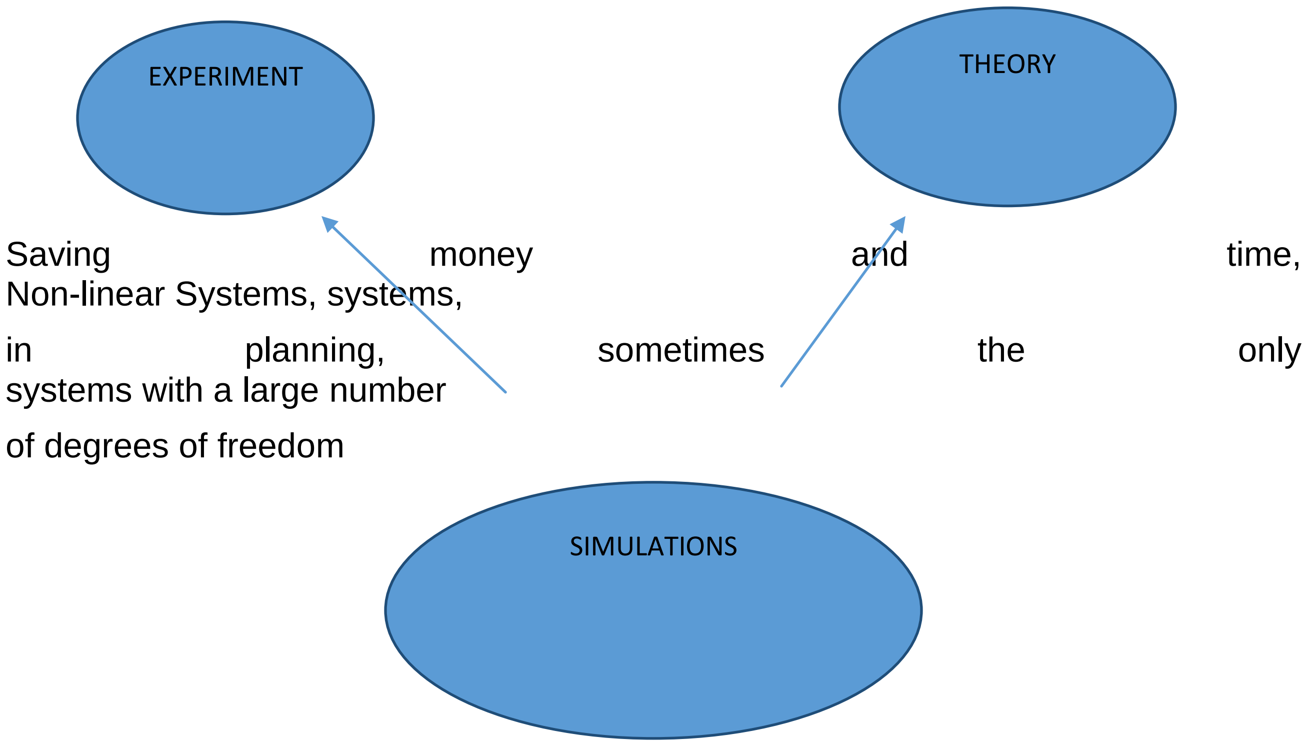
Computer graphics can be used to display the results of a computer simulation. Animations can be used to experience a simulation in real-time, e.g., in training simulations. In some cases animations may also be useful in faster than real-time or even slower than real-time modes. For example, faster than real-time animations can be useful in visualizing the buildup of queues in the simulation of humans evacuating a building. Furthermore, simulation results are often aggregated into static images using various ways of scientific visualization.

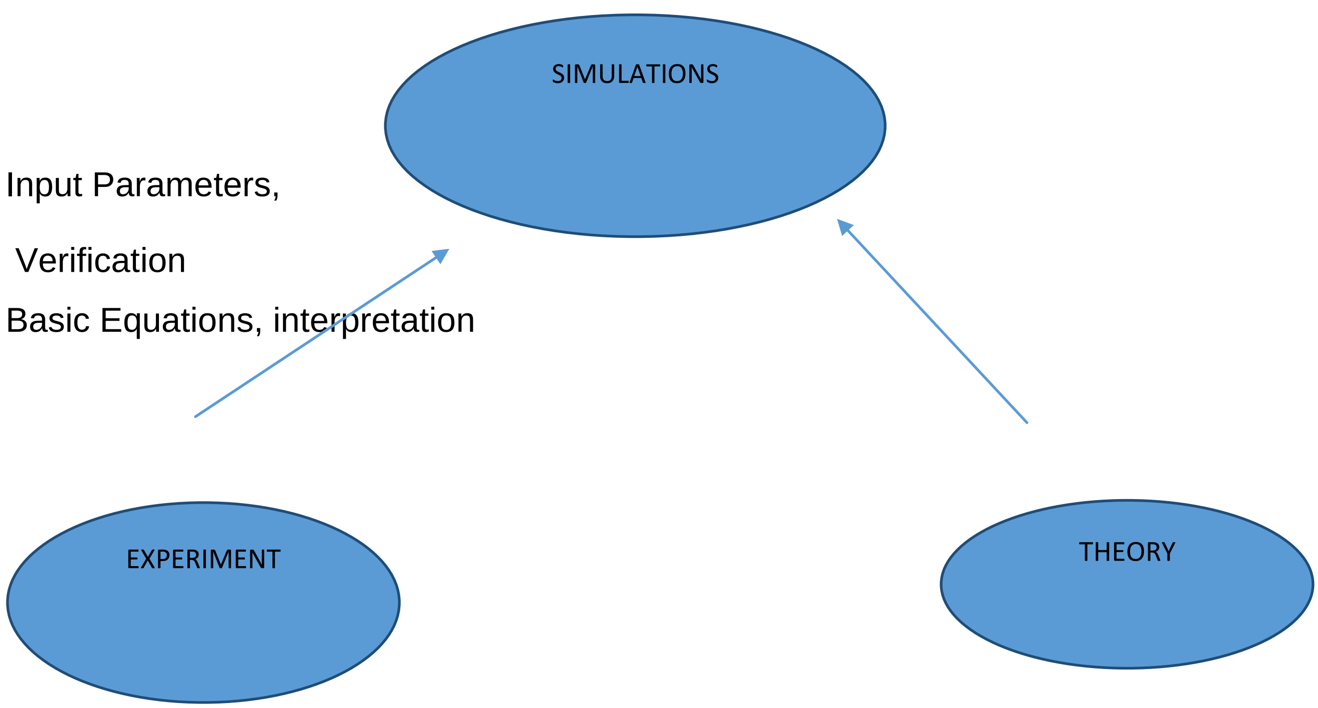
In debugging, simulating a program execution under test (rather than executing natively) can detect far more errors than the hardware itself can detect and, at the same time, log useful debugging information such as instruction trace, memory alterations and instruction counts. This technique can also detect buffer overflow and similar "hard to detect" errors as well as produce performance information and tuning data.

Pitfalls

Although sometimes ignored in computer simulations, it is very important to perform a sensitivity analysis to ensure that the accuracy of the results is properly understood. For example, the probabilistic risk analysis of factors determining the success of an oilfield exploration program involves combining samples from a variety of statistical distributions using the Monte Carlo method. If, for instance, one of the key parameters (e.g., the net ratio of oil-bearing strata) is known to only one significant figure, then the result of the simulation might not be more precise than one significant figure, although it might (misleadingly) be presented as having four significant figures.

Computer simulations In order to define the concept “computer simulation”, let us consider as a simple example the traffic flow in a city. People responsible for traffic planning are probably interested in questions like • How is the traffic flow influenced by building new apartments in a certain area of the town? • What happens to the traffic flow if an accident occurs at intersection A during rush hours? • What happens when a street is closed for repairs? • What happens if the right of precedence is changed, or traffic lights are put up at a certain intersection. Undoubtedly, questions like these are of great importance for the planning of city traffic, and obviously real experiments would not be popular among the inhabitants. On the other hand, it is possible to make a computer model of the city traffic. This model includes the streets with all their intersections, precedence rules, circulation points etc., together with the cars, vans and trucks driving through the city. We can then perform our experiments on the computer model rather than in the town itself, that is, we can perform a computer simulation of the real system. This leads to the following definition of computer simulations: A computer simulation is an experiment performed on a computer model of a real system.1 The advantages of computer simulations are several. In the above example real experiments would not be convenient as they would affect people negatively. From an experimental point of view, computer simulations also have other advantages. Real experiments can be too expensive to perform, or simply impossible from a practical point of view. In such cases simulations may still be possible to use, and can give sufficient information to allow us to, at least partially, achieve what the experiment was aimed to do. Simulations can also be used in the planning stage in order optimize the scientific or financial outcome of an experiment. On the theoretical side, computer simulations are frequently used to handle complex non-linear systems and systems with a large number of degrees of freedom. That is, systems where traditional analytical methods fail to provide a comprehensive solution. Due to the increasing power of computers, computer simulations have evolved as a new concept, a new tool by which we can attack scientific or engineering problems. The traditional two-way interaction between experiment and theory has been replaced by a three-way interaction involving experiment, theory and simulations. As illustrated in figure 1(a), computer simulations can be considered as a support for experiments and theory, in the sense discussed above. However, the student is urged to remember that computer simulations on their own have little value. As illustrated in figure 1(b), every simulation is based on an experimental and theoretical ground. Without the support of experiments providing the essential input, and a theoretical frame work to build the simulation on, computer simulations cannot be performed


EXPERIMENT
THEORY
Saving money and time, Non-linear Systems, systems,
in planning, sometimes the only systems with a large number
of degrees of freedom
SIMULATIONS


SIMULATIONS
Input Parameters,
Verification
Basic Equations, interpretation
EXPERIMENT
THEORY

Schematic illustration of the interaction taking place between the three pillars of science and engineering — experiment, theory and computer simulation.

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3.1.0 LIFE TABLE TECHNIQUES

In actuarial science and demography, a **life table** (also called a **mortality table** or **actuarial table**) is a table which shows, for each age, what the probability is that a person of that age will die before his or her next birthday ("probability of death"). In other words, it represents the survivorship of people from a certain population. (Harper, 2015) They can also be explained as a long-term mathematical way to measure a population's longevity. Tables have been created by demographers including Graunt, Reed and Merrell, Keyfitz, and Greville.

There are two types of life tables used in actuarial science. The period life table represents mortality rates during a specific time period of a certain population. A cohort life table, often referred to as a generation life table, is used to represent the overall mortality rates of a certain population's entire lifetime. They must have had to be born during the same specific time interval. A cohort life table is more frequently used because it is able to make a prediction of any expected changes in mortality rates of a population in the future. This type of table also analyzes patterns in mortality rates that can be observed over time. (Bell, 2015) Both of these types of life tables are created based on an actual population from the present, as well as an educated prediction of the experience of a population in the near future. (Bell, 2015) In order to find the true life expectancy average, 100 years would need to pass and by then finding that data would be of no use as healthcare is continually advancing. (Silcock, 2001)

Other life tables in historical demography may be based on historical records, although these often undercount infants and understate infant mortality, on comparison with other regions with better records, and on mathematical adjustments for varying mortality levels and life expectancies at birth. (Saskia, 2013)

From this starting point, a number of inferences can be derived.

- The probability of surviving any particular year of age
- The remaining life expectancy for people at different ages

Life tables are also used extensively in biology and epidemiology. An area that uses this tool is Social Security. It examines the mortality rates of all the people who have Social Security to decide which actions to take.[3]

The concept is also of importance in product life cycle management.

3.1.1 TYPES OF LIFE-TABLE

- ***Period* or *static* life tables** show the current probability of death (for people of different ages, in the current year)
- ***Cohort* life tables** show the probability of death of people from a given cohort (especially birth year) over the course of their lifetime.

Static life tables sample individuals assuming a stationary population with overlapping generations. "Static life tables" and "cohort life tables" will be identical if population is in equilibrium and environment does not change. If a population were to have a constant number of people each year, it would mean that the probabilities of death from the life table were completely accurate. Also, an exact number of 100,000 people were born each year with no immigration or emigration involved. "Life table" primarily refers to *period* life tables, as cohort life tables can only be constructed using data up to the current point, and distant projections for future mortality.

Life tables can be constructed using projections of future mortality rates, but more often they are a snapshot of age-specific mortality rates in the recent past, and do not necessarily purport to be projections. For these reasons, the older ages represented in a life table may have a greater chance of not being representative of what lives at these ages may experience in future, as it is predicated on current advances in medicine, public health, and safety standards that did not exist in the early years of this cohort. A life table is created by mortality rates and census figures from a certain population, ideally under a closed demographic system. This means that immigration and emigration do not exist when analyzing a cohort. A closed demographic system assumes that migration flows are random and not significant, and that immigrants from other populations have the same risk of death as an individual from the new population. Another benefit from mortality tables is that they can be used to make predictions on demographics or different populations. (Pavia, 2015)

However, there are also weaknesses of the information displayed on life tables. One being that they do not state the overall health of the population. There is more than one disease present in the world, and a person can have more than one disease at different stages simultaneously, introducing the term comorbidity. (Baredregt, 2009). Therefore, life tables also do not show the direct correlation of mortality and morbidity.

The life table observes the mortality experience of a single generation, consisting of 100,000 births, at every age number they can live through. Life tables are usually constructed separately for men and for women because of their substantially different mortality rates. Other characteristics can also be used to distinguish different risks, such as smoking status, occupation, and socioeconomic class.

Life tables can be extended to include other information in addition to mortality, for instance health information to calculate health expectancy. Health expectancies such as disability-adjusted life year and Healthy Life Years are the remaining number of years a person can expect to live in a specific health state, such as free of disability. Two types of life tables are used to divide the life expectancy into life spent in various states:

- **Multi-state life tables** (also known as increment-decrements life tables) are based on transition rates in and out of the different states and to death
- **Prevalence-based life tables** (also known as the Sullivan method) are based on external information on the proportion in each state. Life tables can also be

extended to show life expectancies in different labor force states or marital status states.

Life tables that relate to maternal deaths and infant moralities are important, as they help form family planning programs that work with particular populations. They also help compare a country's average life expectancy with other countries. Comparing life expectancy globally helps countries understand why one country's life expectancy is rising substantially by looking at each other's healthcare, and adopting ideas to their own systems.

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3.2.0 Intranet Application in EHIS

Introduction

Intranet is defined as private network of computers within an organization with its own server and firewall. Moreover we can define Intranet as:

- Intranet is system in which multiple PCs are networked to be connected to each other. PCs in intranet are not available to the world outside of the intranet.
- Usually each company or organization has their own Intranet network and members/employees of that company can access the computers in their intranet.
- Every computer in internet is identified by a unique IP address.
- Each computer in Intranet is also identified by an IP Address, which is unique among the computers in that Intranet. (https://www.tutorialspoint.com/internet_technologies/intranet_overview)

Extranet refers to network within an organization, using internet to connect to the outsiders in controlled manner. It helps to connect businesses with their customers and suppliers and therefore allows working in a collaborative manner. (Tutorials point.com)

An **intranet** is a private network accessible only to an organization's staff (Nielsen & Sano, 1994; Telleen, 1998). Often, a wide range of information and services are available on an organization's internal intranet that are unavailable to the public, unlike the Internet. A company-wide intranet can constitute an important focal point of internal communication and collaboration, and provide a single starting point to access internal and external resources. In its simplest form, an intranet is established with the technologies for local area networks (LANs) and wide area networks (WANs). Many modern intranets have search engines, user profiles, blogs, mobile apps with notifications, and events planning within their infrastructure (Luk, 1991; Richardson &Schoultz, 1991; Rosen, 2006).

Intranets began to appear in a range of larger organizations from 1994.

3.2 1 USES

Increasingly, intranets are being used to deliver tools, e.g. *collaboration* (to facilitate working in groups and teleconferencing) or sophisticated corporate directories, sales and customer relationship management tools, project management etc., to advance productivity.

Intranets are also being used as corporate culture-change platforms. For example, large numbers of employees discussing key issues in an intranet forum application could lead to new ideas in management, productivity, quality, and other corporate issues.

In large intranets, website traffic is often similar to public website traffic and can be better understood by using web metrics software to track overall activity. User surveys also improve intranet website effectiveness.

Larger businesses allow users within their intranet to access public internet through firewall servers. They have the ability to screen messages coming and going, keeping security intact. When part of an intranet is made accessible to customers and others outside the business, it becomes part of an extranet. Businesses can send private messages through the public network, using special encryption/decryption and other security safeguards to connect one part of their intranet to another.

Intranet user-experience, editorial, and technology teams work together to produce in-house sites. Most commonly, intranets are managed by the communications, HR or CIO departments of large organizations, or some combination of these.

Because of the scope and variety of content and the number of system interfaces, intranets of many organizations are much more complex than their respective public websites. Intranets and their use are growing rapidly. According to the Intranet design annual 2007 from Nielsen Norman Group, the number of pages on participants' intranets averaged 200,000 over the years 2001 to 2003 and has grown to an average of 6 million pages over 2005–2007|(Pernice-Coyne *et al,* 2007).

Benefits/Advantages

- **Workforce productivity**: Intranets can help users to locate and view information faster and use applications relevant to their roles and responsibilities. With the help of a web browser interface, users can access data held in any database the organization wants to make available, anytime and — subject to security provisions — from anywhere within the company workstations, increasing the employees ability to perform their jobs faster, more accurately, and with confidence that they have the right information. It also helps to improve the services provided to the users.
- **Time**: Intranets allow organizations to distribute information to employees on an *as-needed* basis; Employees may link to relevant information at their convenience, rather than being distracted indiscriminately by email.
- **Communication**: Intranets can serve as powerful tools for communication within an organization, vertically strategic initiatives that have a global reach throughout the organization. The type of information that can easily be conveyed is the purpose of the initiative and what the initiative is aiming to achieve, who is driving the initiative, results achieved to date, and who to speak to for more information. By providing this information on the intranet, staff have the

opportunity to keep up-to-date with the strategic focus of the organization. Some examples of communication would be chat, email, and/or blogs. A great real-world example of where an intranet helped a company communicate is when Nestle had a number of food processing plants in Scandinavia. Their central support system had to deal with a number of queries every day (McGovern,2002). When Nestle decided to invest in an intranet, they quickly realized the savings. McGovern says the savings from the reduction in query calls was substantially greater than the investment in the intranet.

- **Web publishing** allows cumbersome corporate knowledge to be maintained and easily accessed throughout the company using hypermedia and Web technologies (Christian, 2009). Examples include: employee manuals, benefits documents, company policies, business standards, news feeds, and even training, can be accessed using common Internet standards (Acrobat files, Flash files, CGI applications). Because each business unit can update the online copy of a document, the most recent version is usually available to employees using the intranet.
- **Business operations and management**: Intranets are also being used as a platform for developing and deploying applications to support business operations and decisions across the internetworked enterprise (Christian, 2009).
- **Workflow** - a collective term that reduces delay, such as automating meeting scheduling and vacation planning (Website, 2019).
- **Cost-effective**: Users can view information and data via web-browser rather than maintaining physical documents such as procedure manuals, internal phone list and requisition forms. This can potentially save the business money on printing, duplicating documents, and the environment as well as document maintenance overhead. For example, the HRM company PeopleSoft "derived significant cost savings by shifting HR processes to the intranet"(McGovern,2002). McGovern goes on to say the manual cost of

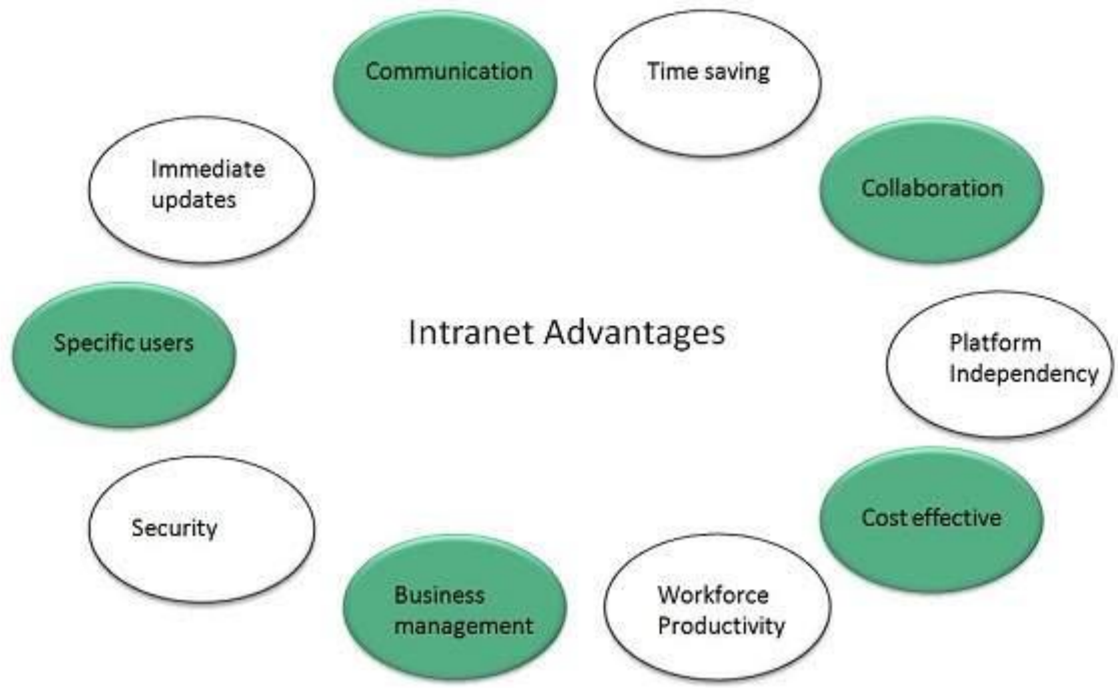
enrolling in benefits was found to be USD109.48 per enrollment. "Shifting this process to the intranet reduced the cost per enrollment to $21.79; a saving of 80 percent". Another company that saved money on expense reports was Cisco. "In 1996, Cisco processed 54,000 reports and the amount of dollars processed was USD19 million". (McGovern,2002).

- **Enhance collaboration**: Information is easily accessible by all authorised users, which enables teamwork (Christian, 2009). Being able to communicate in real-time through integrated third party tools, such as an instant messenger, promotes the sharing of ideas and removes blockages to communication to help boost a business' productivity (Website, 2018).
- **Cross-platform capability**: Standards-compliant web browsers are available for Windows, Mac, and UNIX.
- **Built for one audience**: Many companies dictate computer specifications which, in turn, may allow Intranet developers to write applications that only have to work on one browser (no cross-browser compatibility issues). Being able to specifically address your "viewer" is a great advantage. Since Intranets are user-specific (requiring database/network authentication prior to access), you know exactly who you are interfacing with and can personalize your Intranet based on role (job title, department) or individual ("Congratulations Jane, on your 3rd year with our company!").
- **Promote common corporate culture**: Every user has the ability to view the same information within the Intranet.
- **Immediate updates**: When dealing with the public in any capacity, laws, specifications, and parameters can change. Intranets make it possible to provide your audience with "live" changes so they are kept up-to-date, which can limit a company's liability (Christian, 2009).
- **Supports a distributed computing architecture**: The intranet can also be linked to a company's management information system, for example a time keeping system.

- **Employee Engagement**: Since "involvement in decision making" is one of the main drivers of employee engagement (Website, 2018), offering tools (like forums or surveys) that foster peer-to-peer collaboration and employee participation can make employees feel more valued and involved (Website,2018)

Benefits/Advantages of Intranet in EHIS

Intranet is very efficient and reliable network system for any organization. It is beneficial in every aspect such as collaboration, cost-effectiveness, security, productivity and much more.

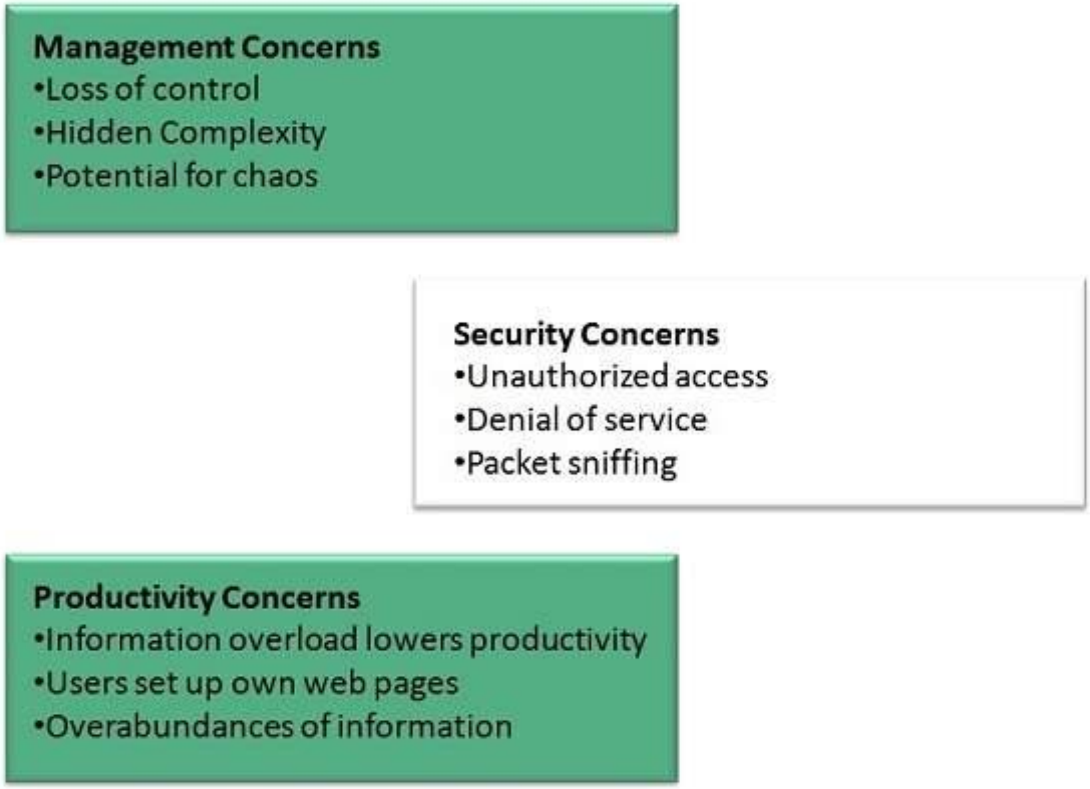


- Communication
- Intranet offers easy and cheap communication within an organization. Employees can communicate using chat, e-mail or blogs.
- Time Saving
- Information on Intranet is shared in real time.
- Collaboration
- Information is distributed among the employees as according to requirement and it can be accessed by the authorized users, resulting in enhanced teamwork.

- Platform Independency
- Intranet can connect computers and other devices with different architecture.
- Cost Effective
- Employees can see the data and other documents using browser rather than printing them and distributing duplicate copies among the employees, which certainly decreases the cost.
- Workforce Productivity
- Data is available at every time and can be accessed using company workstation. This helps the employees work faster.
- Business Management
- It is also possible to deploy applications that support business operations.
- Security
- Since information shared on intranet can only be accessed within an organization, therefore there is almost no chance of being theft.
- Specific Users
- Intranet targets only specific users within an organization therefore, once can exactly know whom he is interacting.
- Immediate Updates
- Any changes made to information are reflected immediately to all the users.

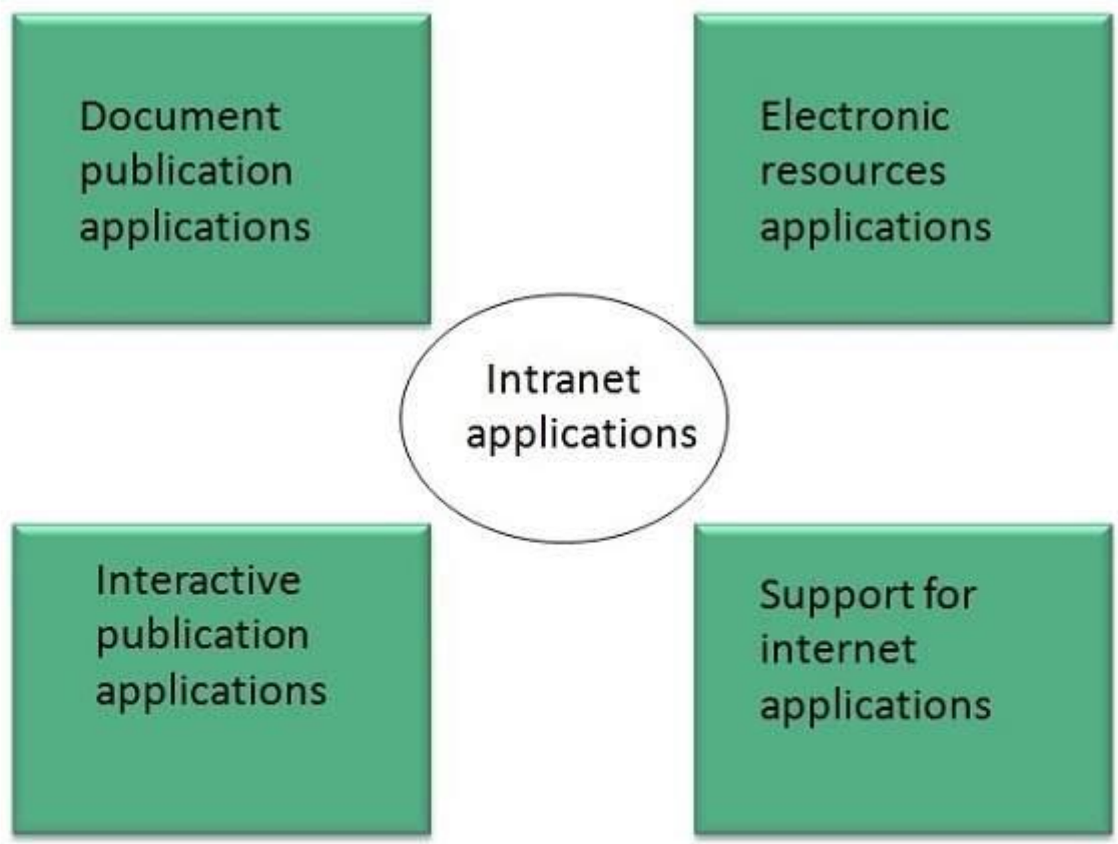
Issues/Disadvantages

Apart from several benefits of Intranet, there also exist some issues/disadvantages. These issues are shown in the following diagram:



Applications

Intranet applications are same as that of Internet applications. Intranet applications are also accessed through a web browser. The only difference is that, Intranet applications reside on local server while Internet applications reside on remote server. Here, we've discussed some of these applications:



Document publication applications

Document publication applications allow publishing documents such as manuals, software guide, employee profits etc without use of paper.

Electronic resources applications

It offers electronic resources such as software applications, templates and tools, to be shared across the network.

Interactive Communication applications

Like on internet, we have e-mail and chat like applications for Intranet, hence offering an interactive communication among employees.

Support for Internet Applications

Intranet offers an environment to deploy and test applications before placing them on Internet.

3.3 INTRANET APPLICATIONS

The most popular intranet application is obviously inter-office e-mail. This capability allows the employees of a company to communicate with each other swiftly and easily. If the intranet has access to the Internet, e-mail can be accessed through the Internet connection. If the intranet is running without the Internet, special e-mail software packages can be bought and installed so that employees can take advantage of its many benefits.

An intranet has many other different applications that can be utilized by a company. These include the Web publishing of corporate documents, Web forms, and Web-to-database links that allow users to access information. Newsletters, information on benefits and 401(k) enrollment, job listings and classifieds, libraries, stock quotes, maps, historical data, catalogs, price lists, information on competitors' products, and customer service data are just a few examples of these types of applications. In addition, there are several other main applications that are very popular in the intranet format.

Every type of company has to deal with forms of some sort. This is another area where paperwork can become a problem for a business. Intranet servers can be equipped with programs that allow for forms to be filled out online. They could also be downloaded and printed out by the users themselves, which would cut down on the time it would take to distribute these forms manually.

Organizational policy and procedure manuals are also handy to have on an intranet. Unlike printed hard copies, online manuals can be easily accessed by all employees at any time. They are also easier to organize online, and can be indexed by subject and attached to a search engine to provide for easier navigation through the manual. In addition, changes can be made more quickly and easily when they are in this format. Converting printed materials to Web browser readable formats is fairly simple and requires either an appropriate html translator or a way for the original word processor documents to be launched with a specific application.

Phone directories are one of the most useful intranet applications. Again, this type of application cuts down on paperwork and the time and money it takes to produce hard copies of these directories. Instead, employee names, titles, duties, departments, phone and fax numbers, e-mail addresses, and even photographs can be stored in an online directory. They then can be easily searched and updated at any time with minimal effort. It is suggested that a few paper copies of the employee directory and other important records be kept on hand in the event that the intranet is experiencing technical difficulties.

Online organizational charts are a useful way for employees to see the hierarchy of their company. These charts can describe who reports to whom, the specific duties of a person or department, and the structure of the organization. They can be set up in either graphic or text formats on an intranet and updated every time there is employee turnover or a change in job title or responsibilities.

An intranet is also a useful tool for employee communication. One way users can share information with fellow employees is through online discussion forums or electronic bulletin boards. This requires special software that allows users to post and reply to messages on a variety of topics. Different forums can be set up with each one dedicated to a different topic. Before such a project is undertaken, employees should be aware of the rules regarding what types of posts are appropriate through a simple list of guidelines. These types of discussion forums should always have some sort of monitor to make sure things are running smoothly.

While somewhat complicated, intranets can be equipped with software to allow for live chat rooms or instant messages so that employees can communicate with each other online about work-related subjects. If a company is considering this form of communication, they should first form a policy about what can be discussed in an intranet chat. Chat room moderators and software to log the chats for future reference should also be considered. Despite these options, it is still difficult to see live online chats replacing traditional company meetings anytime soon.

Online polls or surveys are other useful types of intranet applications. As opposed to actual paper surveys (which have a low return rate because they are often considered a hassle), online polls allow employees to get opinions or information quickly with results that can be viewed instantly. Reductions in paper-work, wasted time, mailing costs, and erroneous data are other benefits of these types of surveys.

Intranet Versus Internet

An intranet often gets confused with the Internet. While there are a lot of similarities between them, they really are two different things. Simply put, the Internet is the global World Wide Web, while an intranet is a private Internet operating within a company. Both the Internet and an intranet use TCP/IP protocol as well as features like e-mail and typical World Wide Web standards. One main difference is that users of an intranet can get on the Internet, but thanks to protection measures like computer firewalls, global Internet users cannot get onto an intranet unless they have access to it. In fact, an intranet can be ran without an Internet connection. While Internet technologies like browsers, servers, and chat scripts are still used, an intranet can be a separate entity as long as its owners do not require that users have access to information found on the Internet.

Differences between Internet and Intranet:

Intranet	**Internet**

Localized Network.	Worldwide Network
Doesn't have access to Intranet	Have access to Internet.
More Expensive	Less Expensive
More Safe	Less Safe
More Reliability	Less Reliability

3.4 Internet and Internet Application in EHIS

The Internet (contraction of interconnected network) is the global system of interconnected computer networks that use the Internet protocol suite (TCP/IP) to link devices worldwide. It is a network of networks that consists of private, public, academic, business, and government networks of local to global scope, linked by a broad array of electronic, wireless, and optical networking technologies. The Internet carries a vast range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), electronic mail, telephony, and file sharing.

The origins of the Internet date back to research commissioned by the federal government of the United States in the 1960s to build robust, fault-tolerant communication with computer networks. (IPTO, 2000) The primary precursor network, the ARPANET, initially served as a backbone for interconnection of regional academic and military networks in the 1980s. The funding of the National Science Foundation Network as a new backbone in the 1980s, as well as private funding for other commercial extensions, led to worldwide participation in the development of new networking technologies, and the merger of many networks. (Stewart, 2000)The linking of commercial networks and enterprises by the early

1990s marked the beginning of the transition to the modern Internet,(Peter,2014) and generated a sustained exponential growth as generations of institutional, personal, and mobile computers were connected to the network. Although the Internet was widely used by academia since the 1980s, commercialization incorporated its services and technologies into virtually every aspect of modern life.

Most traditional communications media, including telephony, radio, television, paper mail and newspapers are reshaped, redefined, or even bypassed by the Internet, giving birth to new services such as email, Internet telephony, Internet television, online music, digital newspapers, and video streaming websites. Newspaper, book, and other print publishing are adapting to website technology, or are reshaped into blogging, web feeds and online news aggregators. The Internet has enabled and accelerated new forms of personal interactions through instant messaging, Internet forums, and social networking. Online shopping has grown exponentially both for major retailers and small businesses and entrepreneurs, as it enables firms to extend their "brick and mortar" presence to serve a larger market or even sell goods and services entirely online. Business-to-business and financial services on the Internet affect supply chains across entire industries.

The Internet has no centralized governance in either technological implementation or policies for access and usage; each constituent network sets its own policies.(Strickland, 2014) Only the overreaching definitions of the two principal name spaces in the Internet, the Internet Protocol address (IP address) space and the Domain Name System (DNS), are directed by a maintainer organization, the Internet Corporation for Assigned Names and Numbers (ICANN). The technical underpinning and standardization of the core protocols is an activity of the Internet Engineering Task Force (IETF), a non-profit organization of loosely affiliated international participants that anyone may associate with by contributing technical expertise. (Hoffman & Harris, 2016) In November 2006, the Internet was included on USA Today's list of New Seven Wonders. (Website)

Internet is defined as an Information super Highway, to access information over the web. However, it can be defined in many ways as follows:

- Internet is a world-wide global system of interconnected computer networks.
- Internet uses the standard Internet Protocol (TCP/IP).
- Every computer in internet is identified by a unique IP address.
- IP Address is a unique set of numbers (such as 110.22.33.114) which identifies a computer location.
- A special computer DNS (Domain Name Server) is used to give name to the IP Address so that user can locate a computer by a name.
- For example, a DNS server will resolve a name http://www.tutorialspoint.com to a particular IP address to uniquely identify the computer on which this website is hosted.
- Internet is accessible to every user all over the world.

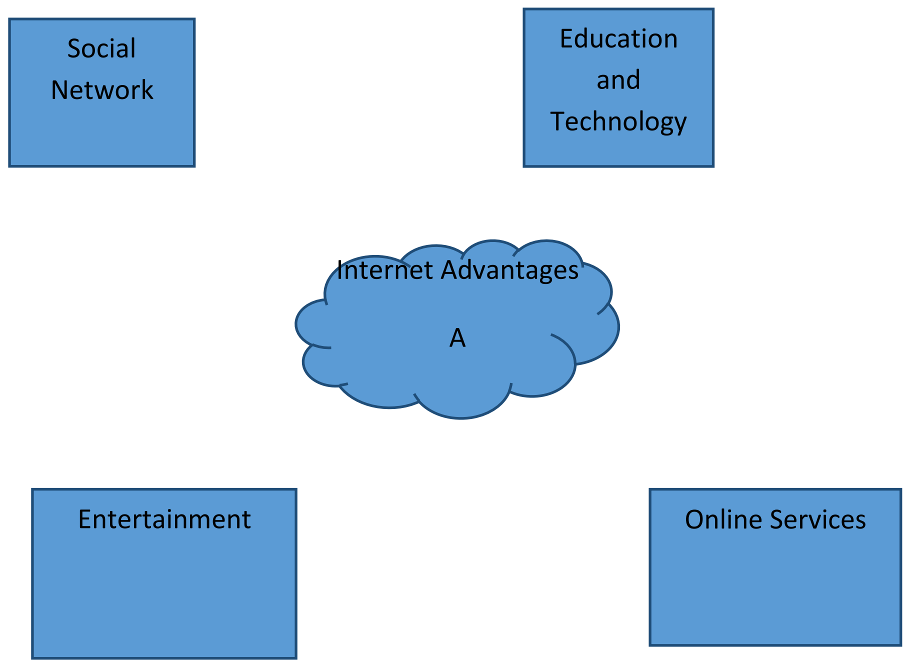
Evolution

The concept of Internet was originated in 1969 and has undergone several technological & Infrastructural changes as discussed below:

- The origin of Internet devised from the concept of Advanced Research Project Agency Network (ARPANET).
- ARPANET was developed by United States Department of Defense.
- Basic purpose of ARPANET was to provide communication among the various bodies of government.
- Initially, there were only four nodes, formally called Hosts.
- In 1972, the ARPANET spread over the globe with 23 nodes located at different countries and thus became known as Internet.
- By the time, with invention of new technologies such as TCP/IP protocols, DNS, WWW, browsers, scripting languages etc. Internet provided a medium to publish and access information over the web.

Advantages

Internet covers almost every aspect of life, one can think of. Here, we will discuss some of the advantages of Internet:



1. Internet allows us to communicate with the people sitting at remote locations. There are various apps available on the wed that uses Internet as a medium for communication. One can find various social networking sites such as:
   - Facebook
   - Twitter
   - Yahoo
   - Google+
   - Flickr
   - Orkut
2. One can surf for any kind of information over the internet. Information regarding various topics such as Technology, Health & Science, Social Studies, Geographical Information, Information Technology, Productsetc can be surfed with help of a search engine.

3. Apart from communication and source of information, internet also serves a medium for entertainment. Following are the various modes for entertainment over internet.

    - Online Television
    - Online Games
    - Songs
    - Videos
    - Social Networking Apps

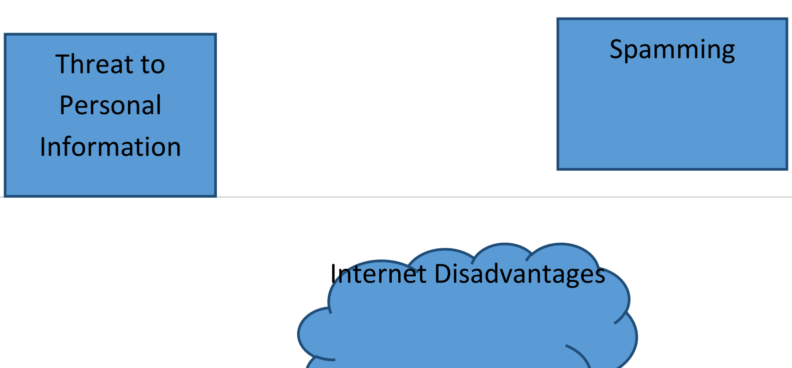
4. Internet allows us to use many services like:

    - Internet Banking
    - Matrimonial Services
    - Online Shopping
    - Online Ticket Booking
    - Online Bill Payment
    - Data Sharing
    - E-mail

5. Internet provides concept of electronic commerce that allows the business deals to be conducted on electronic systems

Disadvantages

However, Internet has proved to be a powerful source of information in almost every field, yet there exists many disadvantages discussed below:



1. There are always chances to loose personal information such as name, address, credit card number. Therefore, one should be very careful while sharing such information. One should use credit cards only through authenticated sites.
2. Another disadvantage is the Spamming. Spamming corresponds to the unwanted e-mails in bulk. These e-mails serve no purpose and lead to obstruction of entire system.
3. Virus can easily be spread to the computers connected to internet. Such virus attacks may cause your system to crash or your important data may get deleted.
4. Also a biggest threat on internet is pornography. There are many pornographic sites that can be found, letting your children to use internet which indirectly affects the children healthy mental life.
5. There are various websites that do not provide the authenticated information. This leads to misconception among many people.

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3.4 Internet: Applications

Internet(/Science-and-technology/computers-and-electrical-engineering/computers-and-computing/internet): Application

The Internet has many important applications. Of the various services available via the Internet, the three most important are e-mail, web browsing, and peer-to-peer services. E-mail, also known as electronic mail, is the most widely used and successful of Internet applications. Web browsing is the application that had the greatest influence in dramatic expansion of the Internet and its use during the 1990s. Peer-to-peer networking is the newest of these three Internet applications, and also the most controversial, because its uses have created problems related to the access and use of copyrighted materials.

3.5 E-Mail

Whether judged by volume, popularity, or impact, e-mail has been and continues to be the principal Internet application. This is despite the fact that the underlying technologies have not been altered significantly since the early 1980s. In recent years, the continuing rapid growth in the use and volume of e-mail has been fueled by two factors. The first is the increasing numbers of Internet Service Providers (ISPs) offering this service, and secondly, because the number of physical devices capable of supporting e-mail has grown to include highly portable devices such as personal digital assistants (PDAs) and cellular telephones.

The volume of e-mail also continues to increase because there are more users, and because users now have the ability to attach documents of various types to e-mail messages. While this has long been possible, the formulation of Multipurpose Internet Mail Extensions (MIME) and its adoption by software developers has made it much easier to send and receive attachments, including word-processed documents, spreadsheets, and graphics. The result is that the volume of traffic generated by e-mail, as measured in terms of the number of data packets moving across the network, has increased dramatically in recent years, contributing significantly to network congestion.

E-mail has become an important part of personal communications for hundreds of millions of people, many of whom have replaced it for letters or telephone calls. In business, e-mail has become an important advertising medium, particularly in instances where the demand for products and services is time sensitive. For example, tickets for an upcoming sporting event are marketed by sending fans an e-mail message with information about availability and prices of the tickets. In addition, e-mail serves, less obviously, as the basis for some of the more important collaborative applications that have been developed, most notably Lotus Notes.

In the near future, voice-driven applications will play a much larger role on the Internet, and e-mail is sure to be one of the areas in which voice-driven applications will emerge most rapidly. E-mail and voice mail will be integrated, and in the process it seems likely that new models for Internet- based messaging will emerge.

Synchronous communication, in the form of the highly popular "instant messaging," may be a precursor of the messaging models of the near future. Currently epitomized by AOL Instant Messenger and Microsoft's Windows Messenger, instant messaging applications generally allow users to share various types of files (including images, sounds, URLs), stream content, and use the Internet as a medium for telephony, as well as exchanging messages with other users in real time and participating in online chat rooms.

Web Browsing

The web browser is another Internet application of critical importance. Unlike e-mail, which was developed and then standardized in the early, noncommercial days of the Internet, the web browser was developed in a highly commercialized environment dominated by such corporations as Microsoft and Netscape, and heavily influenced by the World Wide Web Consortium (W3C). While Microsoft and Netscape have played the most obvious parts in the development of the web browser, particularly from the public perspective, the highly influential role of the W3C may be the most significant in the long term.

Founded in 1994 by Tim Berners-Lee, the original architect of the web, the goal of the W3C has been to develop interoperable technologies that lead the web to its full potential as a forum for communication, collaboration, and commerce. What the W3C has been able to do successfully is to develop and promote the adoption of new, open standards for web-based documents. These standards have been designed to make web documents more expressive (Cascading Style sheets), to provide standardized labeling so that users have a more explicit sense of the content of documents (Platform for Internet Content Selection, or PICS), and to create the basis for more interactive designs (the Extensible Markup Language, or **XML**). Looking ahead, a principal goal of the W3C is to develop capabilities that are in accordance with Berners-Lee's belief that the web should be a highly collaborative information space.

Microsoft and Netscape dominate the market for web browsers, with Microsoft's Internet Explorer holding about three-quarters of the market, and Netscape holding all but a small fraction of the balance. During the first few years of web growth, the competition between Microsoft and Netscape for the browser market was fierce, and both companies invested heavily in the development of their respective browsers. Changes in business conditions toward the end of the 1990s and growing interest in new models of networked information exchange caused each company to focus less intensely on the development of web browsers, resulting in a marked slowing of their development and an increasing disparity between the standards being developed by W3C and the support offered by Internet Explorer or Netscape Navigator.

Now, the future of the web browser may be short-lived, as standards developers and programmers elaborate the basis for network-aware applications that eliminate the need for the all-purpose browser. It is expected that as **protocols** such as XML and the Simple Object Access Protocol (SOAP) grow more sophisticated in design and functionality, an end user's interactions with the web will be framed largely by desktop applications called in the services of specific types of documents called from remote sources.

The open source model has important implications for the future development of web browsers. Because open source versions of Netscape have been developed on a modular basis, and because the source code is available with few constraints on its use, new or improved services can be added quickly and with relative ease. In addition, open source development has accelerated efforts to integrate web browsers and file managers. These efforts, which are aimed at reducing functional distinctions between local and network-accessible resources, may be viewed as an important element in the development of the "seamless" information space that Berners-Lee envisions for the future of the web.

Peer-To-Peer Computing

One of the fastest growing, most controversial, and potentially most important areas of Internet applications is peer-to-peer (P2P) networking. Peer-to-peer networking is based on the sharing of physical resources, such as hard drives, processing cycles, and individual files among computers and other intelligent devices. Unlike client-server networking, where some computers are dedicated to serving other computers, each computer in peer-to-peer networking has equivalent capabilities and responsibilities.

Internet-based peer-to-peer applications position the desktop at the center of a computing matrix, usually on the basis of "cross-network" protocols such as the Simple Object Access Protocol (SOAP) or XML-RPC (Remote Procedure Calling), thus enabling users to participate in the Internet more interactively.

There are two basic P2P models in use today. The first model is based on a central host computer that coordinates the exchange of files by indexing the files available across a network of peer computers. This model has been highly controversial because it has been employed widely to support the unlicensed exchange of commercial sound recordings, software, and other copyrighted materials. Under the second model, which may prove ultimately to be far more important, peer-to-peer applications aggregate and use otherwise idle resources residing on low-end devices to support high-demand computations. For example, a specially designed screensaver running on a networked computer may be employed to process astronomical or medical data.

The Future

The remarkable developments during the late 1990s and early 2000s suggest that making accurate predictions about the next generation of Internet applications is difficult, if not impossible. Two aspects of the future of the Internet that one can be certain of, however, are that network **bandwidth** will be much greater, and that greater bandwidth and its management will be critical factors in the development and deployment of new applications. What will greater bandwidth yield? In the long run, it is difficult to know, but in the short term it seems reasonable to expect new communication models, videoconferencing, increasingly powerful tools for collaborative work across local and wide area networks, and the emergence of the network as a computational service of unprecedented power.

3.6 Electronic Library (E-Library)/Digital Library

An electronic library allows users, to read or refer any published items from their residence or office or college via internet. Users don't need to visit the library directly for their reference.

There are some definitions or explanations for e-library defined by some eminent personalities and publications of standard institutions for e-library. According to the features and functionality, the E-library has been defined as follows.

A-Z of Library Jargon of oxford Brookes University define the term E-library as, Section of the Library Web pages which provides access to databases, electronic journals, electronic books and electronic newspapers (OBU, 2016)

National Diet library, Japan defined the "electronic library concept" as "a library which provides primary and secondary information electronically through communication networks" Putting emphasis on the library as a mode of service, electronic library service, including in-library services, is broadly defined as "service which enables library users to directly access electronic data via telecommunication networks" (NDL, 2016)

Benefits of Electronic Library

Now the academic libraries are shifting to the traditional print resources into e-resource and maintain as Institutional repository. Those resources are theses and dissertations and other innovative academic work done by faculty or students. There sources of institutional repository are distributing via internet or intranet to its user community.

When using electronic information sources, lots of benefits are obtain by the users which include the following:

1. E-libraries are the best tool for providing online resources for research which will make it easy to its users.
2. Retrospective search is easy and most convenient than print resource.
3. Literacy increases when searching is made through e-library, by the educators.
4. Searching of index is also easy.
5. It supports for searching with the combination of keyword.
6. Searching made by patrons for their project to retrieve a manageable amount of content are done quickly and easily.
7. Provision for simultaneous access of multiple file.
8. E-libraries facilitate to its patrons for research solution.
9. Provision for print out and saved the down load items for future references.
10. The distance learners are also searching their requirement from e-library.
11. E-Library provides the benefit to integrated search to dictionary, encyclopedia, almanacs, etc., through the reference desk.
12. The simplest functionality like Point-and-click promotes the users interest.

3.6.2 Digital Library

A digital library, digital repository, or digital collection, is an online database of digital objects that can include text, still images, audio, video, or other digital media formats. Objects can consist of digitized content like print or photographs, as well as originally produced digital content like word processor files or social media posts. In addition to storing content, digital libraries provide means for organizing, searching, and retrieving the content contained in the collection.

Digital libraries can vary immensely in size and scope, and can be maintained by individuals or organizations. (Witten, 2009) The digital content may be stored locally, or accessed remotely via computer networks. These information retrieval systems are able to exchange information with each other through interoperability and sustainability. (Lanagan, 2012)

3.6.1 History

The early history of libraries is poorly documented, but several key thinkers are connected to the emergence of this concept. (Lynch, 2005) Predecessors include Paul Otlet and Henri La Fontaine's Mundaneum, an attempt begun in 1895 to gather and systematically catalogue the world's knowledge, the hope of bringing about world peace. (Stocker, 2014) The establishment of the digital library was total dependent on the progress in the age of the internet. It not only provided the means to compile the digital library but the access to the books by millions of individuals on the World Wide Web.

Vannevar Bush and J.C.R. Licklider are two contributors that advanced this idea into then current technology. Bush was had supported research that led to the bomb that was dropped on Hiroshima. After seeing the disaster, he wanted to create a machine that would show how technology can lead to understanding instead of destruction. This machine would include a desk with two screens, switches and buttons, and a keyboard. (Bush, 1945) He named this the "Memex." This way individual would be able to access stored books and files at a rapid speed. In 1956, Ford Foundation funded Licklider to analyze how libraries could be improved with technology. Almost a decade later, his book entitled "Libraries of the Future" included his vision. He wanted to create a system that would use computers and networks so human knowledge would be accessible for human needs and feedback would be automatic for machine purposes. This system contained three components, the corpus of knowledge, the question, and the answer. Licklider called it a procognitive system.

Early projects centered on the creation of an electronic card catalogue known as Online Public Access Catalog (OPAC). By the 1980s, the success of these endeavors resulted in OPAC replacing the traditional card catalog in many academic, public and special libraries. This permitted libraries to undertake additional rewarding co-operative efforts to support resource sharing and expand access to library materials beyond an individual library.

An early example of a digital library is the Education Resources Information Center (ERIC), a database of education citations and abstracts, which was created in 1964 and made available online through DIALOG in 1969. (Bourne, et al, 2003)

In 1994, digital libraries became visible due to a $24.4 million [NSF] managed program supported jointly by [DARPA]'s Intelligent Integration of Information (I3) program, [NASA], and NSF itself (Website) Successful research proposals came from six U.S. universities (Besser, 2004) The universities included Carnegie Mellon University, University of California-Berkeley, University of Michigan, University of Illinois, University of California-Santa Barbara, and Stanford University. Stanford research, by Sergey Brin and Larry Page led to the founding of Google.

Early attempts at creating a model for digital libraries included the DELOS Digital Library Reference Model (Candela el al, 2007) (Candela el al, 2008) and the 5S Framework. (Goncalves et al, 2004) (Isah, 2013)

<u>Terminology</u>

The term digital libraries was first popularized by the NSF/DARPA/NASA Digital Libraries Initiative in 1994.(Fox, 1999) With the availability of the computer networks the information resources are expected to stay distributed and accessed as needed, whereas in Vannevar Bush's essay As We May Think (1945) they are to be collected and kept within the researcher's Memex.

The term virtual library was initially used interchangeably with digital library, but is now primarily used for libraries that are virtual in other senses (such as libraries which aggregate distributed content). In the early days of digital libraries, there was discussion of the similarities and differences among the terms digital, virtual, and electronic. (Website)

A distinction is often made between content that was created in a digital format, known as born-digital, and information that has been converted from a physical medium, e.g. paper, through digitization. It should also be noted that not all electronic content is in digital data format. The term hybrid library is sometimes used for libraries that have both physical collections and electronic collections. For example, American Memory is a digital library within the Library of Congress.

Some important digital libraries also serve as long term archives, such as arXiv and the Internet Archive. Others, such as the Digital Public Library of America, seek to make digital information from various institutions widely accessible online. (Yi, 2016)

Types of digital libraries

Institutional repositories

Many academic libraries are actively involved in building institutional repositories of the institution's books, papers, theses, and other works which can be digitized or were 'born digital'. Many of these repositories are made available to the general public with few restrictions, in accordance with the goals of open access, in contrast to the publication of research in commercial journals, where the publishers often limit access rights. Institutional, truly free, and corporate repositories are sometimes referred to as digital libraries. Institutional repository software is designed for archiving, organizing, and searching a library's content. Popular open-source solutions include DSpace, EPrints, Digital Commons, and Fedora Commons-based systems Islandora and Samvera. (Castagne, 2016)

Digital archives

Physical archives differ from physical libraries in several ways. Traditionally, archives are defined as:

1. Containing primary sources of information (typically letters and papers directly produced by an individual or organization) rather than the secondary sources found in a library (books, periodicals, etc.).
2. Having their contents organized in groups rather than individual items.
3. Having unique contents.

The technology used to create digital libraries is even more revolutionary for archives since it breaks down the second and third of these general rules. In other words, "digital archives" or "online archives" will still generally contain primary sources, but they are likely to be described individually rather than (or in addition to) in groups or collections. Further, because they are digital, their contents are easily reproducible and may indeed have been reproduced from elsewhere. The Oxford Text Archive is generally considered to be the oldest digital archive of academic physical primary source materials.

Archives differ from libraries in the nature of the materials held. Libraries collect individual published books and serials, or bounded sets of individual items. The books and journals held by libraries are not unique, since multiple copies exist and any given copy will generally prove as satisfactory as any other copy. The material in archives and manuscript libraries are "the unique records of corporate bodies and the papers of individuals and families". (Pitti& Duff 2001)

A fundamental characteristic of archives is that they have to keep the context in which their records have been created and the network of relationships between them in order to preserve their informative content and provide understandable and useful information over time. The fundamental characteristic of archives resides in their hierarchical organization expressing the context by means of the archival bond. Archival descriptions are the fundamental means to describe, understand, retrieve and access archival material. At the digital level, archival descriptions are usually encoded by means of the Encoded Archival Description XML format. The EAD is a standardized electronic representation of archival description which makes it possible to provide union access to detailed archival descriptions and resources in repositories distributed throughout the world.

Given the importance of archives, a dedicated formal model, called NEstedSeTs for Object Hierarchies (NESTOR) (http://nestor.dei.unipd.it/),(Ferro & Silvello,2013) built around their peculiar constituents, has been defined. NESTOR is based on the idea of expressing the hierarchical relationships between objects through the inclusion property between sets, in contrast to the binary relation between nodes exploited by the tree. NESTOR has been used to formally extend the 5S model to define a digital archive as a specific case of digital library able to take into consideration the peculiar features of archives.

Features of digital libraries

The advantages of digital libraries as a means of easily and rapidly accessing books, archives and images of various types are now widely recognized by commercial interests and public bodies alike.(EC,2006)

Traditional libraries are limited by storage space; digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain it. (Pomerants&Marchionini, 2008) As such, the cost of maintaining a digital library can be much lower than that of a traditional library. A physical library must spend large sums of money paying for staff, book maintenance, rent, and additional books. Digital libraries may reduce or, in some instances, do away with these fees. Both types of library require cataloging input to allow users to locate and retrieve material. Digital libraries may be more willing to adopt innovations in technology providing users with improvements in electronic and audio book technology as well as presenting new forms of communication such as wikis and blogs; conventional libraries may consider that providing online access to their OP AC catalog is sufficient. An important advantage to digital conversion is increased accessibility to users. They also increase availability to individuals who may not be traditional patrons of a library, due to geographic location or organizational affiliation.

- No physical boundary. The user of a digital library need not to go to the library physically; people from all over the world can gain access to the same information, as long as an Internet connection is available.
- Round the clock availability A major advantage of digital libraries is that people can gain access 24/7 to the information.
- Multiple access. The same resources can be used simultaneously by a number of institutions and patrons. This may not be the case for copyrighted material: a library may have a license for "lending out" only one copy at a time; this is achieved with a system of digital rights management where a resource can become inaccessible after expiration of the lending period or after the lender chooses to make it inaccessible (equivalent to returning the resource).
- Information retrieval. The user is able to use any search term (word, phrase, title, name, subject) to search the entire collection. Digital libraries can provide very user-friendly interfaces, giving click able access to its resources.
- Preservation and conservation. Digitization is not a long-term preservation solution for physical collections, but does succeed in providing access copies for materials that would otherwise fall to degradation from repeated use. Digitized collections and born-digital objects pose many preservation and conservation concerns that analog materials do not. Please see the following "Problems" section of this page for examples.
- Space. Whereas traditional libraries are limited by storage space, digital libraries have the potential to store much more information, simply because digital information requires very little physical space to contain them and media storage technologies are more affordable than ever before.

- Added value. Certain characteristics of objects, primarily the quality of images, may be improved. Digitization can enhance legibility and remove visible flaws such as stains and discoloration.(Gert,2000)
- Easily accessible.

Drawbacks of digital libraries

Digital libraries, or at least their digital collections, unfortunately also have brought their own problems and challenges in areas such as:

- User authentication for access to collections
- Copyright
- Digital preservation
- Equity of access
- Interface design
- Interoperability between systems and software
- Information organization
- Inefficient or non-existent taxonomy practices
- Training and development
- Quality of metadata
- Exorbitant cost of building/maintaining the terabytes of storage, servers, and redundancies necessary for a functional digital collection.(Robinson, 2015)

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3.7 Geo-informatics

Geo-informatics has been described as "the science and technology dealing with the structure and character of spatial information, its capture, its classification and qualification, its storage, processing, portrayal and dissemination, including the infrastructure necessary to secure optimal use of this information (Raju, 2006) or "the art, science or technology dealing with the acquisition, storage, processing production, presentation and dissemination of geoinformation. (Ehlers, 2008)

Geomatics is a similarly used term which encompasses geoinformatics, but geomatics focuses more so on surveying. Geoinformatics has at its core the technologies supporting the processes of acquiring, analyzing and visualizing spatial data. Both geomatics and geoinformatics include and rely heavily upon the theory and practical implications of geodesy.

Geography and earth science increasingly rely on digital spatial data acquired from remotely sensed images analyzed by geographical information systems (GIS) and visualized on paper or the computer screen. (Boulorcos…..)

Geoinformatics combines geospatial analysis and modeling, development of geospatial databases, information systems design, human-computer interaction and both wired and wireless networking technologies. Geoinformatics uses geocomputation and geovisualization for analyzing geoinformation.

Branches of geoinformatics include:

- Cartography
- Geodesy
- Global Navigation Satellite Systems
- Global Navigation Satellite Systems
- Photogrammetry
- Remote Sensing
- Spatial Analysis
- Web mapping

Research

Research in this field is used to support global and local environmental, energy and security programs. The Geographic Information Science and Technology group of Oak Ridge National Laboratory is supported by various government departments and agencies including the United States Department of Energy. It is currently the only group in the United States Department of Energy National Laboratory System to focus on advanced theory and application research in this field. There are also a lot of interdiscipline research involved in geoinformatics fields including computer science, information technology, software engineering, biogeography, geography, conservation, architecture, spatial analysis and reinforcement learning.

Applications

Many fields benefit from geoinformatics, including urban planning and land use management, in-car navigation systems, virtual globes, public health, local and national gazetteer management, environmental modeling and analysis, military, transport network planning and management, agriculture, meteorology and climate change, oceanography and coupled ocean and atmosphere modelling, business location planning, architecture and archeological reconstruction, telecommunications, criminology and crime simulation, aviation, biodiversity conservation and maritime transport. The importance of the spatial dimension in assessing, monitoring and modelling various issues and problems related to sustainable management of natural resources is recognized all over the world. Geoinformatics becomes very important technology to decision-makers across a wide range of disciplines, industries, commercial sector, environmental agencies, local and national government, research, and academia, national survey and mapping organisations, International organisations, United Nations, emergency services, public health and epidemiology, crime mapping, transportation and infrastructure, information technology industries, GIS consulting firms, environmental management agencies), tourist industry, utility companies, market analysis and e-commerce, mineral exploration, etc. Many government and non-governmental agencies started to use spatial data for managing their day-to-day activities.

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3.8 Elements of Geo-information technology

Geo-information technology consists of Remote Sensing technology, Geographic Information System and Global Positioning System. Details of these technologies are as follows

3.7.1 Remote Sensing

Remote sensing refers to data acquisition through the use of remote measuring instruments and information extraction from measurement data for analysis and processing. The procedure starts from delivering energy from energy sources in order to acquire data, to information extraction from measurement data, and the use of data to support any decision making process. The details of each element are as follows:

- Data acquisition consists of energy sources, interaction of energy with other objects on the global surface, data measurement system, and data recording.
- Information extraction for analysis and processing consists of various steps, including pre-processing calibration development and printing, as well as interpretation which requires the interpreters' background knowledge and understanding, together with field inspections to make the maps and information management:

The history of Remote Sensing development began in the 20th Century, with the use of aerial photographs taken under visible light waves of electromagnetic radiation. The word "photograph" and "image" have different meanings in the aspect of remote sensing. A photograph is a picture recorded on the film while an image is obtained from the record on film or digital record via a scanner system. Therefore, the data is obtained through the use of electromagnetic radiation that has longer wavelength than the visible light waves, such as the Thermal infrared or the Microwave. Since 1960, a number of earth observation satellites have been launched into orbit, such as Landsat, Spot, IRS, and JERS-1, which have spatial resolution of less than 100 meters, and are applied for environmental monitoring. The NOAA Satellite that has lower resolution but cover a larger area is used for meteorological purpose. Other satellites used for meteorological purpose are such as Meteosat or GOES, which are in geostationary orbit following the direction of the Earth's rotation. They orbit around 36,000 kilometers above the Earth's surface, with two remote sensing systems—Passive remote sensing system and Active remote sensing system.

Passive remote sensing system

This is a measurement of electromagnetic energy reflected or emitted from the surface. The energy source in this passive measurement system is solar energy that can give measurable energy in visible and infrared wavelengths. The electromagnetic spectrum that can pass through the atmosphere is called "Atmospheric window" which happens only in the wavelength that is longer than Ultraviolet. If it is shorter, the wave will be absorbed by the atmosphere. The atmospheric window has different wavelengths. The wavelengths that can pass through the atmosphere include visible light waves, Near-infrared radiation, proportion of Thermal infrared (3-5 micrometers and 8-14 micrometers), and Microwave. The energy interaction in atmosphere which causes wave change while it travels to the earth is the scattering process which happens when small particles in the atmosphere have uncertain direction. There are three types of scattering—Rayleigh scattering happens when the particle diameter is smaller than the incident wavelength, causing smog in the atmosphere; Mie scattering happens when the particle diameter is about the same size as the wavelength, such as water, water vapor, and dust particles; Non-selective scattering happens when the particle diameter is larger than the wavelength. The example is water droplets that reflect the visible light waves almost as equally as the infrared, making clouds appear white. Refraction, meanwhile, happens when the light travels through the change of atmospheric density, which causes deviation of image position. Therefore, reflection of a recorded object depends on the atmospheric condition and the wavelengths during measurement.

The examples of passive remote sensing satellites are such as Landsat MSS

(Multispectral scanner) which comprises data in four wavelengths, from green to near-infrared, with spatial resolution of 80 meters, while Landsat 5 TM (Thematic Mapper) consists of data in six wavelengths with spatial resolution of 30 meters, and 120 meters at one Thermal wavelength. The Spot 1, 2 and 3 satellites of France consist of data in two systems. The HRV system has three-wavelength data with spatial resolution of 20 meters, and the Panchromatic system has spatial resolution of 10 meters. Besides, the radiation emission from an object that has temperature above 0-degree Kelvin is also passive remote sensing.

Active remote sensing system

This is a system in which human creates energy and sends the energy to hit the target objects in the microwave spectrum, such as Radar (Radio Detection and Ranging) system which has the wavelength of 1 millimeter to 1 meter. The earth observation satellites that take photos with Radar system include Canada's Radarsat which takes photos at 5.6 cm wavelength (C-Band). Various types of photos are taken, making different image resolutions and width. The ERS satellite, which was sent to the space by the European Space Agency (ESA) can take similar types of photos as that of Radarsat. Both satellites give out electromagnetic waves in different directions. The scattering direction of Electromagnetic fields is called polarization.

The Radarsat sends and receives electromagnetic waves horizontally, while the ERS sends and receives electromagnetic waves vertically. Presently, the earth observation satellites are designed to carry both active and passive remote sensors, such as the JERS-1 and Alos of Japan, and Envisat and ERS of the European Community.

Image analysis and interpretation

The satellite data records images in a digital system in order to represent objects on Earth. The data is stored as arrays of pixel, each pixel having gray level resolution, and being positioned by row and column. The pixel value or digital number is the value recorded from energy reflected from objects on Earth to the measuring device. Procedures in digital data processing and analyzing will help enhance maximum benefits due to the purpose of data use. The steps of image processing are as follows:

- Pre-processing

Raw data obtained from satellite photography will go through the so-called "radiometric correction" process to correct the pixel values deviated during data recording, which is probably caused by the atmospheric noise, such as fog and water vapor, while "geometric correction" is used to correct geometric deformation which happens from data recording and the Earth's rotation. The data will then be adjusted to geo-referenced positions, which require Ground Control Points (GCP) for image adjustment and correction.

Image enhancement is aimed to adjust the gray–level values of image pixels to the new clearer pixel values for easier image interpretation. The adjustment is made in the image histogram.

Image processing

This is a procedure or method to classify pixel values into layers of data classification for pixels grouping under the fixed condition. The first type of image classification is "supervised classification" that will categorize reflection of the wavelengths into various sample groups. Then a training area is designated to represent a variety of characteristics for statistic calculation, such as the average value of each type of data. Such statistical values are used to represent data classification, and this type of image classification requires the use of ground-based data. The other type of image classification is known as "Unsupervised classification", which will classify the data from reflected wavelength values of different objects. The process is called clustering.

Visual image interpretation

Visual image interpretation requires experience, knowledge and understanding about characteristics of the study areas and activities taking place in those areas at different periods of time. Elements of image interpretation include tone and color, size, shape, texture, as well as height and shadow.

2. Geographic Information System

Geographic information system (GIS) is the system that compiles, stores and analyzes data systematically. It can help for data search and improvement, as well as using the analyzed data for decision making process. The data compiled and stored in the system can be used for management and analysis of spatial data, which is linked to attribute data that explains detail of a phenomenon and characteristics of the spatial data to inducecorrectness and precision of data use.

The purpose of GIS use is to support decision making in various issues such as the planning for use of natural resources and management of man-made environment. The GIS data can answer the questions about where the places and things we search for are located and how they are involved with the surrounding objects. Besides, it indicates what choices are available, what their characteristics are, and also makes comparison to find the best option. Data from the geographic information system is a spatial data which can tell the position of our interested Geo-referenced data. The GIS consists of varying data including physical and social characteristics both in terms of quantity and quality of the studied objects. It also indicates the position and time of the objects we are studying.

3.9 Global Navigation Satellite System (GNSS)

The GNSS will receive satellite signal to find geo-referenced position at any spot on Earth throughout 24 hours, without weather limitations. Therefore, it is presently recognized as a good navigation system. The GNSS functions by receiving signals from at least three satellites, which can calculate a position in two dimensions, that is horizontal position. And if the GNSS can receive signals from four satellites up, it can tell a position in three dimensions, which are positioning and the height

3.10 GIScience Trends Related to Globalization

Globalization is a process of interaction and integration among the people, companiesand governments of different nations—a process driven by international trade andinvestment, and aided by information technology. This process affects the environment, culture, political systems, economic development and prosperity, and physical well-being in societies worldwide. Globalization also means the sharing of global resources on an international scale.

Most of the world's natural resources are related to spatial entities, which is why GIS can be used as a powerful tool to depict matters such as the locations, availability, quality/quantity, etc., of the respective resources. Until recently, spatial-analysis methods (including network analysis) and GIS weren't commonly employed by globalization researchers (PDF, 2012). Geologists, climatologists andother Earthscientists, however, have long been using GIS and related methods. A comparative world-systems approach focuses on fourspecific types of social interaction networks:

1. Information
2. Prestige goods
3. Bulk goods
4. Political/military networks

In general, GIS could play a major role in such research, and globalization studies in general, by helping analysis, forecasts and visualization of the variety of spatial interactions and networks involved in global-scale socioeconomic phenomena, including global commodity chains, information flows, labor-migration flows, financial flows, and other aspects of the global economy as well as the relationships among networks of human interaction and natural environments.

Furthermore, GIS-based spatial-analysis techniques can help unlock and visualize the substantial spatial and temporal components of phenomena of interest. In addition to the scientific value of such techniques, GIS helps generate sophisticated visualizations and computer animations that are extremely useful for education and conveying results of globalization research to a wider public.

Globalization research projects can greatly benefit from GIS methods such as spatial analysis, including formal network analysis and scientific visualization techniques such as “time mapping.” These techniques can be used to map and visualize common global phenomena such as natural disasters in real time.

These methods are Web-based, using a Java temporal Web mapping/animation application. In addition, GIS is used to share the spatial data acquired, commonly referred to as spatial infrastructures. The Global Spatial Data Infrastructure (GSDI), for example is a well-known organization that aims to promote international cooperation and collaboration in support of local, national and international spatial data infrastructure developments that allow nations to better address social, economic and environmental issues of pressing importance. This allows all participating nations toprofit from the acquired spatial data, which may be particularly useful in hazard situations such as rapid drought or flood risk.

3.11 Global Business Networks

Global BusinessNetworks (GBNs) refer to astrategy where firmsand members of monitoring groups help businesses, non-governmental organizations and governments use scenario planning for multiple possible futures. The world economy can be seen as a conjunction of spatial entities, based on geographical factors, which play a capital role for consuming resources.

A variety of technology trends are related to GIScience and each other. Two key natural resources from which a country can gain great financial benefit are oil

and natural gas, and GIS can be used to determine the availability or location of such resources. Moreover, GBNs (e.g., labor markets, availability of cotton for textile companies, other agricultural products, etc.) also can be analyzed using a quantitative approach in network analysis.

Currently, industrial and agricultural products are being traded among nations andtherefore are being transported from an area of origin to end consumers. Global transportation and communication networks are examples of global businesstransactions related to air transport, container shipping and telecommunication. GIS could be of major benefit to GBNs by providing a navigation system and related technology for mobile GIS.

3.12 Web GIS

By usingWeb GIStechniques, people can contributeto Web-mapping content and visually interact with data. By setting up a Web server, clients can produce maps and charts published on the Internet, and other clients can view these updates, speeding the evaluation process.

Because of the Internet's near-ubiquitous nature, geospatial data are widely accessible, and clients can work on them from almost any location. These features represent the manner in which geoscientists will work in the very near future.

The combination of easy access to data and their visual presentation addresses some of the primary difficulties in performing geoscience evaluations. Distributing geospatialinformation on theInternet is an enforcingfactor for information providers, allowing society to access geospatialinformation andproviding ameans forprocessing geo-related information with no location restrictions.

Web-based GIS has evolved from various Web-map, client-server and distributed architectures. As such, the Internet reshapes all functions of information systems, including gathering, storing, retrieving, analyzing and visualizing data. Web-based GIS solutions are becoming increasingly attractive compared to conventional GISs. In light of the growing Web-GIS market, and due to the high costs of maintaining and upgrading GISs, the efforts devoted to upgrading the conventional system are increasingly fading. Moreover, disseminating spatial information on the Internet improves decision-making processes.

3.13 Network Analysis

Roads, railways, cables, pipelines, streams and glaciers are phenomena that frequently need to be represented and analyzed as a network. GIS network analysis helps solve these problems, such as finding the most efficient travel route, generating travel directions, finding the closest facility, defining service areas based on travel time, etc.

Networks allow people to examine the important ways in which members andorganizations in different societies are connected with one another as well as the structure of subgroups within societies. GIS canprofitably be combined with network analysis as developed by quantitative sociologists and mathematicians.

Network analysis is a quantitative approach to theinteraction of networks, producing different measures of network structure and function. It includes sophisticated analytic techniques that are little known outside of mathematical sociology.

Spatial Data Sharing and Geo-Corporation

In recent years, access to information, particularly geospatial information, has been a topic of heated discussion. A lot of geospatial data have been created by, or developed specifically for, public bodies.

In some countries, however, data reuse hasbeen severely restricted, although the general consensus is that public-sector geospatial data should be freely accessible for use by citizens and commercial organizations who can add value to the raw data. Many global modeling techniques are based on GIS. Geospatial data producers and users handle a lot of data, and proper documentation will provide them with a keener knowledge of their holdings and allow them to better manage data production, storage, updating and reuse. Ever since the popularization of the Internet in the early 1990s, GIS specialists have been keen to exploit its potential for widespread sharing of geographic data.

The use of geospatial information and simple geospatial data sharing tools have already become mainstream, and high-resolution satellite imagery has been made available to the public (e.g., Google Earth and Google Maps). Based ona policyof

GIS dataset sharing, a lot of information can be derived from data using spatial analysis. With the development of observation technology, numerous datasets are obtained, and the data commonly are shared on the Internet. To account for interoperability, several initiatives have been undertaken, including the Open Geospatial Consortium (OGC), a nonprofit, international, voluntary-consensus standards organization that leads the development of standards for geospatial and location-based services. Currently, OGC has developed several Web-services specifications that enable the interoperability of geospatial data sources in a distributed environment, such as Web Coverage Services (WCS), Web Feature Services (WFS), Web Map Services (WMS) and Catalogue Services (CSW).

3.14 Spatial Analysis

The potential of GIS and spatial analysis for testing causal social-science models of historical development is only beginning to be tapped. In the future, the ability of such models torepresent andanalyze movementand interactionnetworks willbe further elaborated on, as well as techniques that analyze change through time to test complex causal models.

GIS may be combined with other techniques to better meet the objectives ofglobalization research. For example, Hierarchical Linear Modeling (HLM) is used to study causal interactionsamong differentlevels of nestedinteraction networks (e.g., communities, metropolitan areas, regions, etc.). HLM makes it possible to separate the variance into componentsexplaining the effectsof different levels of analysis. This enables the establishing of what relationships at which levels of analysis are of causal nature.

There are obvious methodological issues that need to be addressed in utilizing multilevel GIS databases withhistorical data. Such spatial databasesare naturally hierarchical with multiple levels of analysis: states, counties, cities, census tracts, nations, regional systems of nations and world systems.

The general comparativemethod of non-experimental research design assumes that “cases” (units ofanalysis) are independent instances of the processbeing studied. Because spatial modeling can deal explicitly with the relations of phenomena across geographic scales, HLM, in combination with GIS, may help determine processes' degrees of interdependence as well as the causal power of variable characteristics of different levels of analysis.

3.15 The Internet of Things

The "Internet of Things" refers to uniquely identifiable objects and their virtual representations in an Internet-like structure. The concept of the Internet of Things has become popular through the Auto-ID Center.

Radio-frequency identification (RFID) often is seen as a prerequisite for the Internet of Things. If all objects of daily life were equipped with radio tags, they could be identified and inventoried by computers. GIS provides the basic spatial function for such an infrastructure, including spatial analysis, spatial statistics and decision making.

One of the key characteristics of the Internet of Things is object identification. In addition, GPS can acquire the exact position of each identified object, which would be useful in managing position information. It will help optimize the process from machine to machine; people could track the exact path from a goods producer to its consumer. GIS can monitor the path and find the best way to transfer goods, which will help cut down transportation costs.

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3.16 TELECONFERENCE IN EHIS

A teleconference or teleseminar is the live exchange and mass articulation of information among several persons and machines remote from one another but linked by a telecommunications system. Terms such as audio conferencing, telephone conferencing and phone conferencing are also sometimes used to refer to teleconferencing.

The telecommunications system may support the teleconference by providing one or more of the following: audio, video, and /or data services by one or more means, such as telephone, computer, telegraph, teletypewriter, radio, and television website (2018).

Teleconference using a video link. Simply due to costs, teleconferences are frequently limited to audio links (telephone or computer-based).

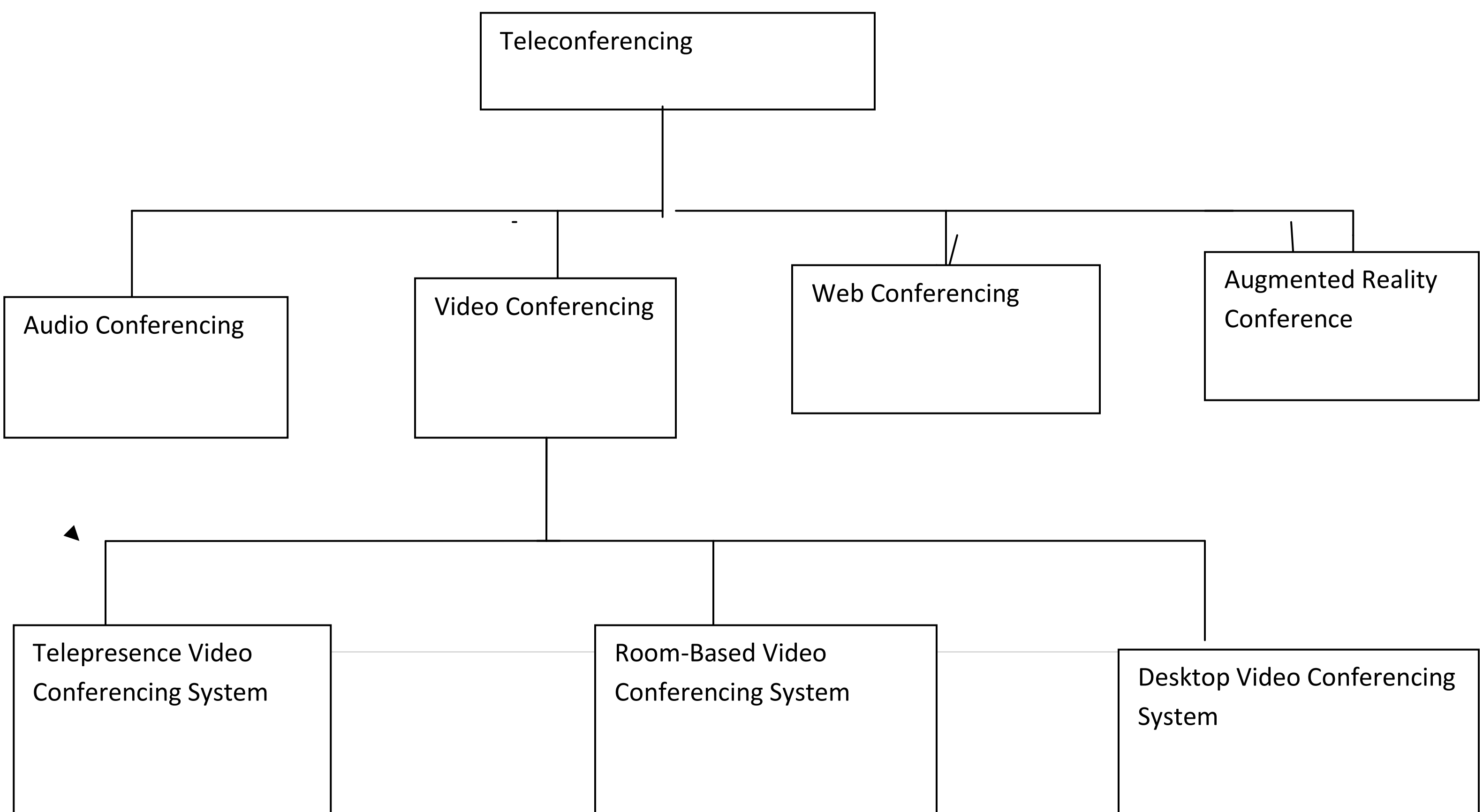
3.17 INTERNET TELECONFERENCING

Internet teleconferencing includes internet telephone conferencing, videoconferencing, web conferencing, and augmented reality conferencing.

Internet telephony involves conducting a teleconference over the Internet or a Wide Area Network. One key technology in this area is Voice over Internet protocol (VOIP). Popular software for personal use includes Skype, Google Talk, Windows Live Messenger and Yahoo! Messenger. (Website2018).

According to Rouse (2008) a teleconference is a telephone meeting among two or more participants involving technology more sophisticated than a simple two-way phone connection. At its simplest, a teleconference can be an audio conference with one or both ends of the conference sharing a speaker phone. With considerably more equipment and special arrangements, a teleconference can be a conference, called a videoconference, in which the participants can see still or motion video images of each other. Because of high bandwidth of video and the opportunity for larger and multiple display screens, a videoconference requires special telecommunication arrangements and a special room at each end. As equipment and high-bandwidth cabling become more commonplace, it's possible that videoconferences can be held from your own computer or even in a mobile setting. One of the special projects of Internet is to explore the possibility of having teleconferences in which all participants actually appear to be in the same room together. Today's audio teleconferences are sometimes arranged over dial-up phone lines using bridging services that provide the necessary equipment for the call.

TELECONFERENCING STRUCTURE



Teleconferencing means meeting through a telecommunications medium. It is a generic term for linking people between two or more locations by electronics. There are at least six types of teleconferencing: audio, audiographic, computer, video, business television (BTV), and distance education. The methods used differ in the technology, but common factors contribute to the shared definition of teleconferencing

- Use a telecommunications channel
- Link people at multiple locations
- Interactive to provide two-way communications
- Dynamic to require users' active participation

3.18 Interactive Technologies

The new systems have varying degrees of interactivity - the capability to talk back to the user. They are enabling and satellites, computers, teletext, viewdata, cassettes, cable, and videodiscs all fit the same emerging pattern. They provide ways for individuals to step out of the mass audiences and take an active role in the process by which information is transmitted. The new technologies are de-massified so that a special message can be exchanged with each individual in a large audience. They are the opposite o mass media and shift control to the user.

Many are asynchronous and can send or receive a message at a time convenient for individuals without being in communication at the same time. This overcomes time as a variable affecting communication. A video, data and voice delivery system reduces travel costs. When the material is retrieved and saved to a video tape or disc, the material can be used at any time or anyplace.

As more interactive technologies emerge, the value of being an independent learner will increase. Research shows that learning from new technologies is as effective as traditional methods. Large groups are cost-effective and everyone gets the same information.

Types of Teleconferences

Audio Teleconference: Voice-only; sometimes called conference calling. Interactively links people in remote locations via telephone lines. Audio bridges tie all lines together. Meetings can be conducted via audio conference. Preplanning is necessary which includes naming a chair, setting an agenda, and providing printed materials to participants ahead of time so that they can be reviewed.

Distance learning can be conducted by audio conference. In fact, it is one of the most underutilized, yet cost effective methods available to education. Instructors should receive training on how to best utilize audio conferences to augment other forms of distance learning.

3.19 Audiographics Teleconference: Uses narrowband telecommunications channels to transmit visual information such as graphics, alpha-numerics, documents, and video pictures as an adjunct to voice communication. Other terms are desk-top computer conferencing and enhanced audio. Devices include electronic tablets/boards; freeze-frame video terminals, integrated graphics systems (as part of personal computers), Fax, remote-access microfiche and slide projectors, optical graphic scanners, and voice/data terminals. Audiographics can be used for meetings and distance learning.

3.20 Computer Teleconference: Uses telephone lines to connect two or more computers and modems. Anything that can be done on a computer can be sent over the lines. It can be synchronous or asynchronous. An example of an asychronousmode is electronic mail. Using electronic mail (E-Mail), memos, reports, updates, newsletters can be sent to anyone on the local area network (LAN) or wide area network (WAN). Items generated on computer which are normally printed and then sent by facsimile can be sent by E-Mail.

Computer conferencing is an emerging area for distance education. Some institutions offer credit programs completely by computer. Students receive texts and workbooks via mail. Through common files assigned to a class which each student can assess, teachers upload syllabi, lectures, grades and remarks. Students download these files, compose their assignment and remarks off-line, then upload them to the common files.

Students and instructors are usually required to log on for a prescribed number of days during the week. Interaction is a large component of the students' grades.

Through computers, faculty, students and administrators have easy access to one another as well as access to database resources provided through libraries. The academic resources of libraries and special resources can be accessed such as OCLC, ERIC, and Internet.

Administrators can access student files, retrieve institutional information from central repositories such as district or system offices, government agencies, or communicate with one another. Other resources can be created such as updates on state or federal legislation.

3.21 Video Teleconference: Combines audio and video to provide voice communications and video images. Can be one-way video/two-way audio, or two-way video/two-way audio. It can display anything that can be captured by a TV camera. The advantage is the capability to display moving images. In two-way audio/video systems, a common application is to show people which creates a social presence that resembles face-to-face meetings and classes and enables participants to see the facial expressions and physical demeanor of participants at remote sites. Graphics are used to enhance understanding. There are three basic systems: freeze frame, compressed, and full-motion video.

Video conferencing is an effective way to use one teacher who teaches to a number of sites. It is very cost effective for classes which may have a small number of students enrolled at each site. In many cases, video conferencing enables the institution or a group of institutions to provide courses which would be canceled due to low enrollment or which could not be supported otherwise because of the cost of providing an instructor in an unusual subject area. Rural areas benefit particularly from classes provided through video conferencing when they work with a larger metropolitan institution that has full-time faculty.

Through teleconferencing, institutions are able to serve all students equitably.

Why Use a Teleconference?

Videoconferencing increases efficiency and results in a more profitable use of limited resources. It is a very personal medium for human issues where face-to-face communications are necessary. When you can see and hear the person you are talking to on a television monitor, they respond as though you were in the same room together. It is an effective alternative to travel which can easily add up to weeks of non-productive time each year. With videoconferencing, you never have to leave the office. Documents are available, and experts can be on hand. A crisis that might take on major proportions if you are out of town, can be handled because you're on the job. Videoconferencing maximizes efficiency because it provides a way to meet with several groups in different locations, at the same time.

As the limited resource of funding has decreased, limited resources now include instructors, parking spaces and buildings. Students now include time as a limited resources. Teleconferencing enables institutions to share facilities and instructors which will increase our ability to serve students.

Move Information - Not People

Electronic delivery is more efficient than physically moving people to a site, whether it is a faculty member or administrator.

Save Time: Content presented by one or many sources is received in many places simultaneously and instantly. Travel is reduced resulting in more productive time. Communication is improved and meetings are more efficient. It adds a competitive edge that face-to-face meetings do not.

Lower Costs: Costs (travel, meals, lodging) are reduced by keeping employees in the office, speeding up product development cycles, improving performance through frequent meetings with timely information.

Accessible: Through any origination site in the world. Larger Audiences: More people can attend. The larger the audience, the lower the cost per person.

Larger Audiences: More people can attend. The larger the audience, the lower cost per person.

Adaptable: Useful for business, associations, hospitals, and institutions to discuss, inform, train, educate or present.

Flexible: With a remote receive or transmit truck, a transmit or receive site can be located anywhere.

Security: Signals can be encrypted (scrambled) when it is necessary. Encryption prevents outside viewers.

Unity: Provides a shared sense of identity. People feel more a part of the group...more often. Individuals or groups at multiple locations can be linked frequently.

Timely: For time-critical information, sites can be linked quickly. An audio or point-to-point teleconference can be convened in three minutes.

Interactive: Dynamic; requires the user's active participation. It enhances personal communication. When used well for learning, the interactivity will enhance the learning and the teaching experience.

Satellite Communications

Long distance telephone calls, national and international televised sporting events, and cable movie channels operate via satellites. Satellites have been used for years.

Geostationary Orbit: British physicist and science fiction writer, Sir Arthur C. Clarke, invented satellite communication in his 1954 paper Wireless World, which explained this east-west orbit, 22,300 miles above the equator; three satellites based in this orbit could provide world-wide communications. Today, many satellites are arrayed in the Clarke belt. To earth stations, they appear fixed in space.

Satellite Footprint: In geostationary orbit, communications satellites have direct line-of-sight to almost half the earth - a large "footprint" which is a major advantage. A signal sent via satellite can be transmitted simultaneously to every U.S. city. Many downlinks can be aimed at one satellite and each can receive the same program; this is called point to multipoint.

Transponders: Via an uplink, video, audio or data signals can be transmitted to a satellite transponder. There may be up to 40 transponders per satellite; each can amplify and relay signals to earth which are picked up by earth stations.

C/Ku-Band: Domestic communications satellites operate on two frequency ranges designated C- and Ku-band. Each requires specific electronic equipment. C-band is less expensive; operates at 4 kHz. Ku-band operates at 12 kHz. Some teleconferences are broadcast on both bands.

Receivers: Convert satellite signals into channels viewed (one at a time) on a TV monitor; designed to tune-in the format, bandwidth, and audio sub-carrier. Programs broadcast in code (encryption) are decoded at receive sites.

Basic Receivers: Lowest cost; limited (or manual) channel tuning capability; may use fixed antennas.

Multi-Format Receivers: Most versatile; adjusts for all broadcast formats; receive any satellite video program in six or more bandwidth selections, and two agile audio subcarrier switches; usually a motorized system.

Fixed Position System: Low cost systems limited to reception from one satellite and one band.

Motorized System: Receives programs on different satellites by adjusting the dish position.

Automated Systems: Microprocessor controlled for instant movement to satellites (positions stored in memory).

International Satellite

Alpha Lyracom Space Communications/Pan American Satellite is the world's first private international satellite system. PAS-1 carries many specialized communications services including full and part-time video, low and high speed data, broadcast data and radio and business television to over 70 countries on three continents. It can be seen (received) by a 2.4 meter antenna. It has 18 C-band and six Ku-band transponders with a shared capacity that increases traffic.

PanAmSat handles all phases of an international broadcast as compared to INTELSAT (International Telecommunications Satellite Organization) where the customer must book the domestic and foreign half circuits and pay for each downlink. INTELSAT was established primarily to handle the PTT telephone transmissions, while PanAmSat was established to be easily accessible by distance education institutions and private enterprise. The FCC licenses PanAmSattransportables for years, as compared to the FCC special temporary authority (STA) license for INTELSAT. PanAmSattransportables can uplink from any location without a special license.

PanAmSat writes yearly contracts with customers. It does not charge for multiple downlinks. Time on PAS-1 books from between $960 to $2,400 per hour depending on the volume discount based on yearly usage.To book time on PAS-1, call the day-of-air or future event number, with the origination site, uplink, downlink sites, and conference time.PanAmSat handles the rest. By booking time through satellite brokers (EDS, PSN, Satellite Management International) ad hoc users can reduce time costs. PanAmSat is negotiating for three more satellites to be in place in 1994-95.

Compressed Video

Digital compression means that the codec compresses the video signal or data to a fraction of its original size so that the data rate is appropriate to transmit over low-cost terrestrial telephone lines or on a fraction of a satellite transponder. Codecs (COder/DECorder) compress the video and audio signal allowing it to be transmitted in a smaller bandwidth which reduces the cost of the transmission.

Standard transmission rates for video teleconferencing are multiples of 64 Kbs up to the T1 rate of 1.54 Mbs. Some codecs allow speed selection to match the circuit used. The speed selected is based on the content. When close to full motion video is needed, higher rates are needed.

T1 circuits connect PBXs to the telephone company's central office and can carry up to 24 voice channels at a lower cost than 24 voice circuits. A 56 Kb or 64 KBS codec operates in the range of one voice channel. A standard video signal digitized at 90 Mbs is comprised of about 1400 voice channels.

Freeze Frame Video

Freeze frame video uses telephone channels to transmit video information. Because of the narrow bandwidth, the image takes a few moments to reach the receive site where it appears on the TV as a still picture. The advantages are lower costs and flexibility in linking multiple sites. Slow scan systems are similar to freeze frame and the terms are often used synonymously.

Freeze frame technologies include a range of features; analog, digital, monochrome or color pictures, resolutions, transmission speeds, and extra memory. Newer models provide multiple send times to select the resolution and transmission time through digital circuits and compression coding. Some units transmit video information in digital format over a data circuit which reduces the transmission time to about nine seconds to a 56 kilobit link. Because of the faster transmission rates, many new freeze frame applications use data circuits

Compressed video (near motion) and full-motion video differ; compressed video uses compression techniques to reduce channel bandwidth; images may not look as natural and may blur or lose background resolution. The advantage is that the significant reduction in bandwidth reduces costs. Compressed video uses a telephone data circuit - currently a T1 carrier or 1.5 or 3 megabits - to transmit video, voice and data. It reduces video information (NTSC Standard-color video) with a compression technique to eliminate redundant information and reduce the 100 million bits signal to 1.5 or 3 million bits.

Digital video signals are broken down into thousands of elements called pixels. Between frames, many are the same. A codec takes advantage of this duplication by sending complete information on the first pixel and a brief code to repeat the values. This reduces the information sent and the bandwidth required. Interframe coding for conditional replenishment compares the changes between two frames and transmits changes. Motion compensation predicts changes between frames and transmits only the difference. Software holds the compression algorithm which can be upgraded. The CCITT Px64 international standard requires rates to operate in multiples of 64.

Full-Motion Video

Standard TV signals are broadcast using a significant amount of the bandwidth of wideband channels - 4 to 6 megahertz for color analog - to send video, voice and data. Because of the large channel capacity, it transmits a picture with the full motion and resolution of broadcast TV. The bandwidth used is the digital equivalent of 80 Mbps or more which corresponds to a full satellite transponder or 1820 voice phone lines. This translates into high costs for signal transmission.

Compression for One-Way Video

Consumer applications for compressed video systems use higher rates than two-way compressed video to achieve near-broadcast quality video image. A digitally compressed video signal can be broadcast over 1/20 of a regular transponder channel reducing costs to under $200 per hour.

One use of the technology is SKY PIX, a pay per view movie service based on a Compression Labs, Inc. codec marketed by NW Star Scan which offers viewers a choice of up to 40 movies. The picture quality is better than VHS transmission quality. Scientific Atlanta offers PrimeStar, a competing entertainment service, which transmits at a data rate of 4 to 4.5 Mbs. Using the same technology, they will offer B-Mac users compatibility with compressed video users at a lower price because the transmission uses a fraction of a regular transponder channel.

Compression Labs, Inc. has recently introduced the SpectrumSaver System which can broadcast a digital signal to a fraction of a satellite transponder. Because up to 15 or 18 signals can be carried on a transponder (depending upon the system configuration), the cost of satellite time is significantly reduced. The National Technological University (NTU) is using the system, as well as ITESM in Mexico.

Each institution reports a savings of $1 million in satellite time during the first year of operation. The system is entirely digital.

Scientific Atlanta is about to bring its new digital satellite system to the market. This system is an upgrade to an existing Scientific Atlanta analog satellite system. As such, users will be able to broadcast in either analog or digital format.

Fiber Optic Systems

The transmission of voice, video and data by light wave signals inside a thin, transparent glass fiber cable, is providing more choices for telecommunications users and is rapidly bringing digital communication to the home and office. One pair of fibers can carry up to 10,000 telephone calls simultaneously. Advantages: transmission clarity, speed, accuracy, security, and volume. Disadvantages: Construction, installation and maintenance costs, but they are declining.

Advantages and Disadvantages of Teleconferencing (EZTALKS, 2017).

There are many achievements that have been made in the telecommunication industry over the last century. Among the modern marvels of technology is teleconferencing. This technology is widely used in many companies to facilitate organizational meetings over the digital sphere.

Over the last few years, teleconferencing technology has achieved some immense milestones. Today, it is possible to conduct a video conference across platforms and devices without any limitations. All this has meant massive gains for business communication. Even with all the gains, there still are many challenges and disadvantages associated with this technology. Here is a quick look at the various Advantages and disadvantages of teleconferencing.

Advantages of Teleconferencing

1. Saves Time – The most important advantage of teleconferencing is time-saving. With teleconferencing, it is possible to hold meetings on a very short notice. In addition, there is no time spent traveling to the venue of a meeting as all meetings are held through machines or Internet. Reduced mileage translates to thousands of

hours of travel saved every year. Teleconferencing also encourages punctuality as meetings are scheduled and done at fixed time frames.

2. Save on Travel Expenses – In addition to time, travel costs can be quite significant when added up over a long period. Most companies that have a global reach incur massive costs associated with the travel ever year. Teleconferencing, however, removes the need to travel often and thus saves huge company resources. Attend meeting thousands of miles away is now faster and less cumbersome.

3. Efficient Record Keeping – One of the main teleconferencing advantages is efficient meeting recording keeping. Computing devices are able to record, keep logs and track every detail of a particular online meeting without needing a lot of monitoring. This makes teleconferencing facilities among the best tools for capturing and storing important meeting data. Teleconferencing also makes it very easy to retrieve this data in the future and make references whenever necessary.

4. Cut Conference Costs – There are indeed many logistical costs associated with holding a conference. Hiring equipment, acquiring a venue, buying food and refreshment are just some of the normal costs associated with any meeting. Teleconferencing removes all these costs as no such arrangements need to be made. The flexibility of teleconferencing also ensures that meetings are held as often as possible with no extra costs being incurred.

5. Encourage Productivity – The fifth teleconferencing advantage is that teleconferencing ensures that workers at various hierarchies in the company structure are in constant communication. This translates to effective information-sharing and prompt actions. Such recurrent engagement is a motivational factor that results turns out increased productivity. Teleconferencing also makes multi-branch management easier as the proximity of every department of a company is optimized.

6. Reliability – Teleconferencing is one of the most reliable ways of holding meetings. This reliability has increased exponentially over the years due to advancement in technology. Teleconferencing channels are today much more stable

and communication challenges are almost non-existent. It is also a very secure mode of communication where the safety of data as well as privacy is guaranteed.

Disadvantages of Teleconferencing

1. **Prone to Technical Challenges** – The main difference between machines and humans is that machines are prone to wear and tear. Technical challenges can thus hit teleconferencing systems at any time. This can lead to time wastage and other inconveniences. Most technological systems also come with a learning curve. Lack of know-how can hinder a person from effective utilization of teleconferencing facilities.

2. **Less Effective Nonverbal Communication** – When compared to an actual meeting, teleconferencing is a less effective mode of business communication. This is because important nonverbal aspects of business communication like body language and human contact are disregarded. Nonverbal cues are very crucial to holistic communication. The lack of such cues makes it impossible to pick important signals that could lead to a more productive interaction.

3**. Space Limitations** – The fact that teleconferencing occurs on a screen means that a lot of information is disregarded due to limited space. It is, for instance, nearly impossible to deliver all graphical data effectively even when holding a live online meeting. Even with a big screen, simultaneous actions are not possible in the same way they are at an actual meeting. Consequently, some information is lost or not effectively covered.

4. **Discourages Team Dynamics** – Another teleconferencing disadvantage is that teleconferencing lacks the dynamism of a real conference where participants are able to have a shared engagement and raise or respond to issues instantaneously. This means that it is often difficult to effectively interject or share ideas as they arise. The lack of dynamism ultimately leads to few people taking control of meetings at the expense of other people.

5. **Eliminate Informal Interactions** – The common pre-meeting and post-meeting conversations are often very important in setting the stage for the day's agenda and even future meeting agendas. Such informal engagements are also where some key

ideas arise concerning important matters like policy and planning. With the lack of such small talk, teleconferencing can be seen as a rigid and non-progressive mode of conferencing.

6. **Affect Professionalism** – The fact that machines are the main intermediary between the different parties involved in the meeting,which can affect professionalism. This is because participants are often forced to multitask. This multitasking can shift the focus of participants to other issues that are unrelated and not beneficial to the meeting.

Conclusion

The above are teleconferencing advantages and disadvantages. As we know, teleconferencing is undoubtedly one of the most common ways of holding meetings in the modern world. This means of communication is preferred by companies for different reasons. Most of the advantages of teleconferencing are very easy to see, especially when other options of holding meetings are put into context, while the limitations are sometimes not so easy to see.

In general, there are many advantages and disadvantages of teleconferencing that can arise, depending on the specific context of those involved and it is not possible to highlight all of them. For the large part, however, the points covered here apply to most teleconferencing situations.

What Is Teleconferencing?

Nowadays business is global and no one can stop this trend now. One thing that has emerged and has become tremendously popular is teleconferencing. What is teleconferencing? It has become the future wave, since the majority of people have started to work from home and run own business. Since there are so many diversities in locations, and communication being the most significant thing, so it needs a sophisticated solution. This demand has boosted teleconferencing products to be more available and be more popular.

What Is a Teleconference?

Do you know what does teleconference mean? Teleconferencing definition is basically meeting with telecommunications medium. This is a general term to link people at two or more locations with electronics.

It is a telephone meeting with two participants or more that involves in technology, which is more sophisticated than a two-way simple phone connection. Teleconference at its simplest case, is when an audio conference is done with both or one ends of the conference that shares a speaker phone. The audio teleconferences of today are arranged on dial-up phone lines sometimes and use bridging services to offer necessary equipment for the call.

When there are many more equipment having special arrangements considerably, it is called a video teleconferencing where participants can view motion or still video images of each other. Now the modern technologies have made it possible for teleconference to have every participant appear as if they are present in the same room.

There are different types of teleconferencing and different methods are used in each technology, but some common factors like telecommunication channel, interactive two-way communications, linking people at multiple locations and dynamic users' active participation always contribute to the teleconference definition.;

Types of Teleconferencing

In the part above, we have introduced you the teleconference definition. In the following part, we'd like to share you the different types of teleconferencing to get you better understood.

Type 1. **Video Teleconferencing**

This mode of teleconference is a combination of video and audio for providing video communications. There can be various modes like one-way video or two-way audio and two-way video or two-way audio. It displays anything captured by TV camera and mainly used for displaying moving images. Since the bandwidth of video is high and there is opportunity for multiple, large display screens, video teleconferencing will need special telecommunication arrangements made with a special room at each end. High-bandwidth cabling or equipment has become more commonplace, so video teleconferencing may be done from one's own mobile setting and also on the computer.

There're various video teleconferencing solutions for you to keep communicate and connect with colleagues, customers and others. Among all ezTalks Meetings stands out. It's versatile and reliable, which provides you with high-definition audio and video, meeting scheduling, screen sharing and content sharing, meeting recording and playback and more to simplify your teleconferencing services.

Type 2. **Audio Teleconferencing**

Audio teleconferencing is also called Voice-only or known as conference calling sometimes. It can interactively link people at remote locations through telephone lines. Audio bridges basically tie every line together. Meetings may be conducted through audio conferencing where preplanning is required. Activities like chair naming, setting of the agenda, along with offering printed materials for participants are done earlier so that it can be reviewed.

Distance learning is also one application of audio conference, which is a cost effective solution for education.

Type 3**. Audiographics Teleconferencing**

Here narrowband telecommunications channels are used for transmission of visual information like alpha-numerics, graphics, documents, or video pictures like adjunct for voice communication. Also called as enhanced audio or desktop computer conferencing. Devices like electronic tablets, freeze-frame video terminals, remote-access microfiche, Fax, integrated graphics systems, slide projectors uses this teleconferencing mode.

Type 4. **Web Teleconferencing;**

As for web teleconferencing, telephone lines are used for connecting two or more modems and computers. Any program done on the computer may be sent through lines, and it may asynchronous or synchronous. An asynchronous mode example is electronic mail.

Web conferencing is also very helpful in distance education. Now some institutions are offering credit programs by computer completely and students get texts trough mail.

Conclusion

Teleconferencing can increase results and efficiency in a profitable way by using limited resources. Some of the pros are easy communication at long distances, ability of relaying information to most people at one go. Flying abroad for addressing a business partner or attending meeting is no longer necessary, thus saving time and money. But some issues of teleconferencing are that there is no face to face contact and service maybe lacking if it is a wrong provider, and fees can be substantial. All in all, teleconferencing helps boost business, education, medicine and more industries. You can select a suitable type of teleconferencing to ease your telecommunication and collaboration.

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