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INFORMATION AND KNOWLEDGE:
IN QUEST OF BOUNDARIES

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ABBREVIATIONS
ASCII – American Standard Code for Information Interchange
BIOS – British Intelligence Objectives Subcommittee
CIOS – Combined Intelligence Objectives Subcommittee
DNA – Deoxyribonucleic acid
Fig. - Figure
NTIS – National Technical Information System

INTRODUCTION
Librarians all over the world primarily deals with documents and varying degree of information. Take for example while dealing with the book *Theory of Classification* by Krishan Kumar [1], a librarian will gather the information from recto and verso of the title page. With that s/he will classify, catalogue, decide subject headings, etc. When the processing is over the book will be placed on the shelf for use by the readers. This particular book of Krishan Kumar contains 10 preliminary pages and 510 textual pages, in total 520 pages. Of these 520 pages, the librarian has gathered information only from two pages. That means he has used only about 0.4% of the information contained in the book.

A librarian is not to be blamed for this, because s/he is to deal with all the subjects under the sun with his/her subject knowledge of bachelor's degree or Master's degree in which s/he has gained knowledge in three or four subjects. Hence, it cannot be expected that a librarian will be knowledgeable in all subjects.

There is another factor that cannot be undermined. That is the language factor. A librarian of our country knows generally two or three languages, i.e. English, Hindi and the mother tongue, if his/her mother tongue is not Hindi. We have seen the presence of books in six or seven languages in the college and university libraries of Delhi. Nehru University library has books in many more languages. I like to highlight my experience of Nehru Memorial Museum and Library where I worked for about two years during its retroconversion. The Library contains books in about 45 languages. There was no problem with English and Hindi books, the workers and data entry operators could handle the books in most cases. The rest of the books used to pile up on my table. Using my little knowledge of various languages and other methods I had to decipher the basic data about each book for classification and cataloguing.

Taking all these into account, it may be stated that a librarian generally uses on average about one percent of the information contained in a document.

A reference librarian is to make himself familiar with the content of a document to provide good reference service. Obviously, he uses more information contained in a document.

A librarian who is the only trained professional in the library has also to use more information contained in a document to provide good reference service.

Sometimes, a librarian/ information scientist (hereinafter referred to as LIS professional) also acts as an abstractor. While abstracting an article he is to go through the entire article. We may say that he uses cent per cent information contained in the article for preparing the abstract.

Nowadays, an LIS professional uses varied types of information for retrieving needed information from World Wide Web (also referred as Web). In fact, we are to use their knowledge of information retrieval.

The sum and substance of all these is to say that we LIS professionals have been using information up to varied degrees to process books, render reference service, prepare abstracts, and search Web.

In recognition of this fact, the name of our course changed from library science to library and information science and a new species of profession called information scientist came into being.

There was no problem as far as we were dealing with information. Sometime back in the corporate world the concept of knowledge management came into being. We also incorporated it in our courses. I feel, this led to the confusion amongst us about the concepts – information and knowledge.

In an LIS conference, a debate cropped up basing these two concepts. Surprisingly it was found out that no one was having clear-cut idea information and knowledge. We were confused. A noted professor of our profession uses the words 'information and knowledge' together. He rarely uses the words separately.

Here, I am making a modest attempt to differentiate between the two. First, I deal with 'information' and 'knowledge' separately, then together. It is up to you to judge to what extent I am successful.

INFORMATION

DEFINITIONS

The definitions of information varies from dictionary to dictionary as well as from subject to subject. Sometimes it is equated with data, knowledge, facts, etc adding to confusion. Some definitions are even difficult for LIS professionals to understand. Let us go through some of the definitions.

1) The communication or reception of knowledge or intelligence [2].
   Note: Knowledge once communicated becomes information. Once an individual receives knowledge, s/he becomes knowledgeable. Now if s/he communicates this knowledge, it will become information. The meaning of the word 'intelligence' is not very clear. Maybe it is secret information, because till the time secret information is communicated or received there will not be any information. For example, a border patrol has detected an intrusion in a territory. Till the patrol communicates the incidence, there will not be any information.

2) News, advice, or knowledge communicated by others or obtained by personal study and investigation [3].

Note: News, advice, or knowledge when communicated will become information. There is no problem with the first part of the definition. When we study a news given in a newspaper or advice given in a letter, we become informed. By conducting an investigation, an investigator obtains knowledge about it. Till he communicates his knowledge there will not be any information. As can be seen this definition to a certain extent is flawed.

3). Information consists of statements made by individuals about concepts which they have assimilated into their store of knowledge [5].

    Note: The implication of this definition is that the statement whether or not it is recorded, it will be information. In our day-to-day life, we make hundreds of statements which are not recorded. The statements made may be true or false. Even a false statement is information. In courts all over the world witnesses at times make false statements which are also considered information. An individual makes statements based on his/her store of knowledge.

4) The attribute inherent in and communicated by one of two or more alternative sequences or arrangement of something (as nucleotides in DNA or binary digits in a computer program) that produce specific effects [2].

    Note: This definition is applicable to **biosciences, communication science, computer science**, etc and so on and difficult to understand for a commoner. A particular sequence of nucleotides in DNA represent a particular information. The moment the sequence changes, the information also changes. Let me illustrate this point with the help of binary digits. The binary digit comprises 0 and 1. With these two digits we represent all types of information. Let us take ASCII code. It is a eight bit code meaning that for representing a number, a letter, a punctuation mark, etc we use these two digits in such a way that their total number is always eight. For example, 1 is represented with 01010001, 2 is represented with 01010010 wherein the total number of zeros and ones is 8. In this representation, each of the digits is called a bit. Now, you may notice that while representing 2, the sequence of the last two digits has been changed. In this way by changing the sequence of zeros and ones, we get the representation for the Indic numerals, English letters (both capital and small), punctuation marks, some symbols etc.

5) A signal or character representing data [2].

    Note: I feel, in this definition, the word 'data' has been used loosely. In fact, here data has been more or less equated with information. We all know about traffic signals, where red means 'stop', yellow means 'get ready' and green means 'go'. Here, each colour is disseminating a specific information not data. In broadcasting, information, messages, pictures, etc are converted into electromagnetic signals suitable for the channel and then the signals are transmitted from the transmitting station. When these signals are picked by the receiver (radio, TV) they are reconverted into information, messages, and so on. Here also, signals when reconverted becomes information.

    Take the characters C, N and O. In chemistry C represents carbon, N nitrogen and O oxygen. As such they provide information. At times they may be regarded as data also.

6) Something (as a message, experimental data, or a picture) which justifies change in a construct (as a plan or theory) that represents physical or mental experience or another construct [2].

    Note: The definition is not easy to understand. Let us try to understand the concept 'construct'. A construct is an idea inferred or derived from specific instances. The idea may be abstract or general. Till the publication of the book *De Revolutionibus Orbium Coelestium* by Nicolaus Copernicus (1473-1543) the people of the world knew that the universe including the Sun revolves around the Earth. As the people got the message contained in the book, gradually an gradually the construct changed and the people started believing that the Earth revolves around the Sun. In fact, it changed the mental map of the people.

7) A formal accusation of a crime made by a prosecuting officer as distinguished from an indictment presented by a grand jury [2].

    Note: This definition pertains to **law.**

8) Any data that can be stored in and retrieved from a computer [5].

Note: This definition belongs to **computer science**. Here also data has been equated with information.

9) Data that have been processed into an organised, usable form and are meaningful to the recipient for the task at hand [6].
Note: This definition also belongs to **computer science** and contradicts the definition given above. From this definition it is clear that data is the raw material for information. When it is processed into organised, usable and meaning form it becomes information. It clearly distinguishes between 'data' and 'information'.

10). Information is data which is used in decision making [7].
Note: Here also data has been equated with information. This definition pertains to **management** where decision making is a key element. It has a number of derived implications. One is that information is a relative quantity, relative to the situation, and to the time when a decision is made, and to the decision maker and the decision maker's background and history. This differs form the physical world, where the quantities involved are generally absolute. A second implication is that information and decision making are closely intertwined.

From the definitions given above, it is clear that no single definition is possible for 'information'. As information is the basic constituent of each and every subject the definition is bound to vary from subject to subject. It has also been seen in the definitions that the term 'information' has been equated with data more often than not.

CHARACTERISTICS

Communicability
One of the most basic characteristics of information is communicability. Language and medium are two essential factors needed for communication.

Language
Languages of various types. The languages in which we speak are natural languages like Hindi and English. Apart from natural languages, there are sign languages, machine languages, artificial languages, cryptic languages, and so on. Deaf and dumb persons communicate through a sign language. Computers use machine languages. Artificial languages like Esperanto also exist. Secret information is communicated through cryptic languages.

It is possible to communicate information expressed in a particular language to one or more languages of the world. The holy book *Bible* has been translated in over 450 languages of the world [8]. In international conferences it is common practice to provide simultaneous translation of a lecture in several languages.

Medium
For communication a medium is but sine qua non. The mediums are many and varied.

During our normal conversation we use air as the medium. When we speak, waves are generated in the air that travel all around and reaches the listener. This mode of communication carries information only up to a certain distance. Using mechanical devices, the reach of information can be increased further.

For long distance communication we use wire for telephony, and electromagnetic waves for broadcasting. Using electromagnetic waves information can be sent millions of miles away. When we send information to spacecraft orbiting planets like and Mars and Jupiter, we use electromagnetic waves.

Material mediums like stone, papyrus, parchment, vellum, paper, etc. have been used to transmit information for millennia. Ashoka the Great, got his messages inscribed on stones in 3rd century BC. Those messages have been transmitted generations after generations for millennia. Even today, milestones convey information about the distance between two places. In ancient time, papyrus, parchment, vellum, etc have been used for writing and transmitting information. In India, palm leaves and *bhurjapatras* were used for long for writing. Thousands and thousands of manuscripts written on these leaves still exist in many Indian libraries.

Paper was discovered in China in early 2nd century AD. Since then it has been used as a writing and printing medium. Even today we write letters in postcards, print information about marriage and other ceremonies on cards made of paper, to transmit information. In 1450s printing from movable types was discovered by Johannes Gutenberg of Germany. Paper served as a great medium for printing. Since 1450s, millions of books, periodicals and other similar materials have been printed to record and transmit information.

In 20th century, quite a few new mediums appeared on the scene to record and transmit information. They include among others microfilms, microfiche, magnetic tapes, compact discs (CDs), and pen drives. CDs and pen drives have enormous capacity to record and transmit information.

Representability

Information can be represented with signals, signs, and symbols.

Signals

We have already talked about traffic signals. With the movement of the head we convey 'yes' or 'no'. Dances of various forms convey various messages. A police conveys messages to the travelers with various signals made with hands. A lighthouse with its powerful light informs passing ships about the port, shoal, and so on. Messages are also conveyed through smoke, drum beating, etc. A tiger through urination informs about its boundary. Many such examples can be provided where messages are conveyed with signals. Various traffic signals such as a railway crossing, no honking, etc are presented with pictures. A picture of a skull with crossed bones signals danger.

Signs

A sign indicates silent and non-verbal communication. Laughter is a sign of joy, weeping is a sign of sorrow, rainbow is a sign of falling water droplets in the sky, etc.

Symbols

Symbols are of numerous types. All are used to present information. With linguistic symbols like a, b, c, d etc we compose words which convey information. Words when arranged in a meaning sequence also present information. Mathematical symbols like +, -, %, <, >, etc represent plus, minus, percentage, less than, greater than, etc. Chemical symbols like NaCl represents sodium chloride, NH$_3$ represents ammonia, etc. Symbols are used in numerous subjects to represent various concepts. We may use a completely different set of symbols for cryptic language.

Presentability

Depending on the situation information is presented in different ways. When a lecturer delivers his/her lecture he usually tries to present information in a lucid way so that everybody understands it. On the other hand a scholar may present his information in a pedantic way. Teachers, trade representatives, demonstrators, conference participants and many others present information using transparencies, slides, video recordings, etc. making the presentation colourful and easily comprehensible. Nowadays for making colourful presentation, people use the software Power Point. While presenting information, teachers also gives explanation wherever needed. In children's encyclopedias information is presented in simple language with colourful pictures so that children can easily comprehend the content. It may not be the case with scholarly encyclopedias. When a military commander gives a command, the presentation of information is different than a request made by a common man for some favour from somebody.

Expressibility

Information is expressible in diverse ways. It may be expressed in plane language, flowery language, metaphoric language, etc.

Recordability

It is really a fortunate matter that information has the wonderful property of being recorded. It is because of this property huge amount of information of the ancient world has survived till date. Otherwise most of the information would have vanished. We have already talked under many media above on which information has been recorded. Those apart, information has been recorded on walls of buildings, obelisks, pillars (e.g. Iron pillar at Qutb Minar site), monuments like Taj Mahal and Pyramid, barks **,** bones**,** clothe**s,** metallic sheets, stones, glasses, plastic sheets, and what not.

Ancient Hindus devised a novel method of preserving information for centuries after centuries without recording it in a material medium. The method was *Shruti* and *Smriti* (Listen and remember). *Vedas*, the holy books of Hindus survived by virtue of this method.

Translatability

We have already seen that information can be translated from one language to many languages. It is because of this particular characteristic of information we have been able to read great epics like *Ramayana, Mahabharata, Iliad, Odyssey, Paradise Lost*; unparallel treatises like *Revolutions* of Copernicus and *Principia* of Newton; holy books like *Gita, Qoran* and *Bible.*   Knowledge created all over the world through all ages in hundreds of languages has come to our door through translations. In our school days we all read Euclid's geometry. It was written around 300 BC in Greek. No one knows when the original book of Euclid was lost forever. Fortunately for us the Arabic translation of the book survived. The Latin version of the book was translated from Arabic, and the English version was from Latin, and from English version, it was translated to many other languages of the world including Indian languages. In English the book is called *Elements*. Had Arabic translation not survived we would never have seen this book.

Experiments are going on for long for machine translation, with which translation of texts from one language to another will be done mechanically. Some success in this direction has been achieved. You may use Google translation in Internet to have a feel of this.

Translation of the same text by different translators differs to a certain extent. However, the overall meaning more or less remains the same. There are various types of translation as indicated below:

i) Natural to natural language (Ex. English to Chinese, Chinese to English)

ii) Natural to machine language and vice-versa .
Texts and sounds of any language can be translated into machine language. Similarly the text translated into machine language can be translated back to the source language.

iii) Natural to sign language and vice versa.
In the radio broadcast for deaf and dumb, and in many other cases, information is translated from natural languages to sign language. Translation from sign language to natural language is also possible.

There are many other types of translation. Examples of only three types are given above.

Condensability
Information is condensable. This very property or characteristic of information has given rise to abbreviations, abstracts, summaries, digests, and so on.

Abbreviations
A shortened form of a word or group of words used in writing to save space and time is called an abbreviation. There are several types of abbreviations as listed below. In abbreviations there is a preponderance of capital letters, small letters are also used, but there number is less.

Types: General, Initialisms, Acronyms, Alpha-numeric abbreviations, Uppercase-lowercase abbreviations

General Abbreviations
In general abbreviations, one or more letters of a word are used. Examples
a – acceleration, adjective, acre, ampere, etc.
acct. – account
natl. - national
Estd. – Established

Initialisms
An initialism is an abbreviation comprising only the initial letters of a grouip of words. Examples
AEC - Atomic Energy Commission
AIDS - acquired immunodeficiency syndrome
APO - Army Post Office, etc.
CCC – Classified Catalogue Code
DDC – Dewey Decimal Classification

Acronyms

An acronym is an abbreviation that is pronounceable as words and many a time written both in capital letters and small letters.

> LASER, Laser, laser - light amplification by stimulated emission of radiation.
>
> UNESCO, Unesco - United Nations Educational, Scientific and Cultural Organization
>
> IASLIC – Indian Association of Special Libraries and Information Centres.
>
> SAIL - Steel Authority of India Limited

Upper case-lower case abbreviations

In this type of abbreviations both upper case letters (capital letters) and lower case letters (small letters) are used. Examples:

> MoU – Memorandum of Understanding
>
> PhD – Doctor of Philosophy
>
> MeSH – Medical Subject Headings

Alpha-numeric abbreviations

In this type of abbreviations both numbers and letters are used.

> Y2K - Year 2000
>
> AACR II - Anglo-American Cataloguing Rules 2nd edition
>
> DDC 22 – Dewey Decimal Classification 22nd edition

Properties

Abbreviations have properties some of which are mentioned below.

i)   It saves printing space and writing time.

Let us take the abbreviation INTUC. It stands for Indian National Trade Union Congress. In a page if this name appears five times it will take space for minimum three to four lines. That amount of space will be saved using the abbreviation. Similarly writing or typing time will be saved. The normal practice is that if in a text a name, phrase, etc appears a number of times, the expanded form is used only once along with the abbreviation at the place where the expanded form appears for the first time in the text. Afterwards only the abbreviation is used.

ii)   Quite often, an abbreviation stands for more than one item giving rise to homonymy.

For example, ISI stands for both Indian Statistical Institute, and Institute of Scientific Information, etc. To remove any misunderstanding the expanded form of the abbreviation must be given in the text at least once. Synonymy is also observed in some abbreviations. A.M. and a.m. mean the same, i.e. *ante meridiem,* before noon

iii) At times use of capital letter and small letter give rise to different meaning. Example: GB – Gigabyte, Gb – Gigabit.

Condensed form of texts

The characteristic of condensability of information has given birth to various types of abstracts, summaries, digests, etc. of texts. Let us discuss this.

Abstracts – Depending on the size of the abstracts they have been named as annotations, indicative abstracts, informative abstracts, extended abstracts, and so on. We all know about them, hence discussion on them is uncalled for here.

Summaries- In our school days we were taught to write précis. A précis is a summary. Even today, the grammar by Wren and Martin[9] contains a chapter on précis writing. In the instruction for précis writing, it is suggested that the précis should present the main theme of the text in 'as few words as possible. It should be lucid, succinct and full,… and shorn of all unimportant details'. So that by reading it anyone will be able to grasp the main points. As to the length of the précis it is suggested that the 'précis should not contain more than a third of the number of words in the original passage'.

Digests – Many of us are familiar with the world famous magazine *Reader's Digest*. Under the heading Bonus Read this magazine provides the digest of a book. In January 2012 issue of the magazine appears the digest of the book *The Spy's Kid* by Bryan Denson. Along with pictures the digest appears in eight pages. The digest is also a condensation or a summary. The length of the summary is not fixed and depends upon the requirement.

Equations – Scientists provide highly condensed information in the form of equations. Einstein gave the world famous relativity equation $E = mc^2$. The small formula paved the way for the manufacture of atom bomb. In the formula E stands for energy, m for mass, and c for velocity of light per second, i.e. 300,000,000 cm. That means one gram of mass will generate 1 x 300,000,000 x 300,000,000 joules of energy when fully converted. Similarly, the formula $2H_2 + O_2 = 2H_2O$ contains the following information. Two molecules of hydrogen combing with one molecule of oxygen produce one molecule of water. .

Expandability

In the aforesaid paragraph it has been shown how from condensed information expanded information can be generated. In our school we all have done the exercises on 'Expand the idea' such as 'United we stand, divided we fall', 'The child is father of the man', etc. That showed us information condensed in a line can be expanded into a paragraph, even into an essay. Full form of abbreviations are also expansion of their short form.

Suppressibility

Information has got a tendency to come out. Many defence, nuclear technology, aerospace and intelligence reports which were once classified as top secret has been made public afterwards. Examples: BIOS reports, CIOS reports, many NTIS reports, etc. Nowadays, through Wikileaks, a lot of secret information is coming out. Henry Kissinger called "The Indians are bastards", and Indira Gandhi a "bitch", President Nixon also called India Gandhi an "old witch". It was disclosed in the BBC News several years ago [10]. All these prove that knowledge is difficult to suppress.

People for various reasons try to suppress information, even murder is not uncommon in the process. In most cases, the information comes at a later date. In rare cases information may not come out. We do not know yet what happened to Netaji after 1945.

Repackagability

Information can be repackaged. This very characteristic of information has given rise to dictionaries, encyclopedias, handbooks, and various other reference sources. In this process information is gathered from various sources and then presented in a particular form.

Saleability

Just like any other commercial product, information can be sold. For selling information various information products like books, periodicals, and newspapers are produced and sold.

There are numerous e-books, e-journals, etc which can be consulted only on payment basis. If you want to search and download information from commercial databases you are to pay. The saleability of information has given rise to a big industry called information industry.

Usability

Information is used all and sundry. A judge uses information to give verdict in court cases. A doctor gathers information from the patient to diagnose the ailment of the patient. A pilot uses information to safely fly and land. A farmer uses information to increase the yield of the crops. A government uses information in numerous ways in order to save people from difficulties, disasters and diseases; provide relief to the people affected by various untoward happenings like floods, fires, earthquakes, and accidents; maintain law and order in the country; and so on. Innovators use information to manufacture various devices and products. In every activity of human life information is being used. In fact, a volume can be written on the use of information.

It is not that information is always used properly. There are many instances of **abuse** and **misuse** of information.

When information is used for causing physical and mental harm to anybody it may be termed as abuse of information. Getting the cue from Einstein's relativity equation $E = mc^2$, scientists developed atom bomb that was responsible for the killing of lakhs of people in Hiroshima and Nagasaki. A band of dacoits get information that a marriage party is travelling in a particular train with lots of valuables. They attack the marriage party and loot the party members. This is another case of abuse of information. Blackmailing, threatening people with dire consequences, e-mail bombing, etc are also the cases of information abuse.

When gathered information is not used, or information is used for personal gain or fun, it may be termed as misuse of information. It has been seen that students in many cases gather huge amount of information for study, preparing project report, etc. Ultimately, only a fraction of the information gathered is used. A large part remains unused. Copying from a scrap of paper or a book in the examination hall is also misuse of information. On April fool's day many people send wrong information for fun. All these instances are misuse of information.

Forgability

Forging of information especially wills is an age old phenomenon. Numerous forgery cases have been there in the courts. Even today forgery is not uncommon. Information contained in a document is changed with the intention of gaining benefit. Suppose in a will it was written that the elder son will get 1 acre of paternal land. The elder son can easily make 1 as 10 and cheat his younger brother. A famous case of forgery took

place in 1983. On 22nd April 1983, the West German magazine *Stern* reported that 62 volumes of diaries by Adolf Hitler belonging to the period 1932 to 1935 was recovered from the wreckage of a plane that crashed near Dresden. *Stern* published an instalment of the diary and offered the rights to other publishers. Handwriting analysis plus chemical analysis of the binding, glue, paper and ink proved beyond doubt that the diaries were not original but forged [11].

Fluidity

Information flows. Flow dynamics of information varies from mode to mode and from subject to subject. Information flows through various modes covering various distances taking from a split second to a month or more. There may be noise in the flow. Table 1 depicts the flow of information through various media, mode, etc.

Table 1 - Flow of information

Media	Mode	Time	Distance	Noise
Primitive	Oral, drum beating, fire Messenger	Few seconds Days	Short Short	Present Present
Writing	Messenger, Postal communication	Days to months	No limit	Nil
Printing	Messenger, Postal communication	Days to months	No limit	Nil
Audio-Visual	Messenger, Postal communication	Days to months	No limit	Nil
Electric	Telegraph, telephone, telex, fax,	Almost instantaneous	No limit	Present
Electro-magnetic Wave	mobile phone, walkie-talkie, radio, TV	Almost instantaneous	No limit	Present
Internet	Computer	Almost instantaneous	No limit	Little

Types of Flow

Information flows horizontally and vertically. In a tea garden of North Bengal a tiger with her cubs was spotted by a labourer. He informed the labourer next to him. The next labourer in turn informed the third labourer. In this way the news spread to all the labourers working in the garden. This is the horizontal flow of information.

Vertical flow of information is of two types - Top-down flow, and bottom-up flow. In top-down flow information flows from top to down as shown in Fig. 1. In bottom-up flow information flows from bottom upwards. In a village in Bihar, there was a virulent pest attack on Taichung rice field. The farmer of the village informed the block development minister (BDO). The BDO informed the district collector. He in turn informed in the agriculture minister of the State. The minister contacted the central minister of agriculture in New Delhi. The central minister made arrangements

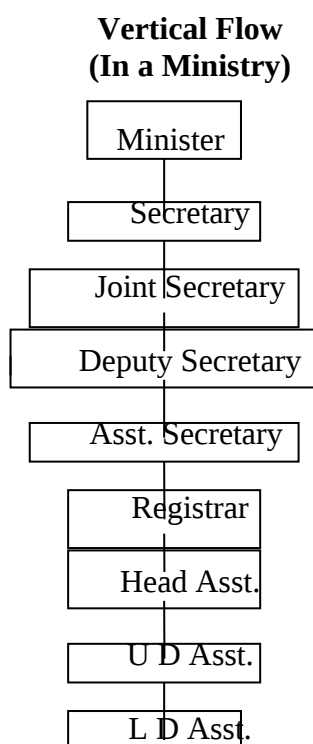for sending the pest control expert to the village. This is an example of the bottom-up flow of information.

**Vertical Flow
(In a Ministry)**

Minister

| Secretary |

| Joint Secretary |

| Deputy Secretary |

| Asst. Secretary |

| Registrar |

| Head Asst. |

| U D Asst. |

| L D Asst. |

Fig. 1 – Vertical (top down) flow of information

Flow speed

Information does not flow with equal speed in all cases. Some information, say, speech of the head of the state, on-going sports and games, disasters and accidents, etc flows very fast. The speech by our President whenever broadcast, we get the information instantly. Information on cricket and football matches, lawn tennis, and so on that are broadcast reaches us without any loss of time. On the other hand the research results of a scientific experiment may reach us about a year or more after the experiment was over.

Table 2 – Speed of information flow at various events/ phenomena

Topics	**Speed**
Natural phenomena	
Celestial phenomena	Slow
Weather	
Rain, draught	Slow
Storm, flood	Very Fast
Earthquakes, volcanic eruptions	Very Fast
Accidents & disasters	Very Fast
Religious activities	Slow
Political & governmental activities	Varies
Business and commercial activities	Very Fast
Crimes and legal activities	Fast

Educational activities	Slow
Scientific & Technological activities	Slow
Sports & games	Fast
Literary activities	Slow
Cultural activities	Slow

Let me give one or two examples of the speed of information flow in the past and present. Archaelogists have found evidences of paper in China even in 2nd century BC. However, the invention of papermaking is attributed to Tsai Luhn when he made a formal announcement of the discovery of papermaking in 105 AD. Table 3 shows how the art of papermaking travelled from country to country.

Table 3 –Flow speed of information in the past

105 AD	China
610 AD	Japan
704 AD	Samarkand
794 AD	Bagdad
900 AD	Arabia
1189 AD	Moorish Spain
1276 AD	Italy
1320 AD	Germany (Mainz)

Now let us see how fast scientific information flows at present. The flow of scientific information involves a number of steps. Research by experimentation, observation and survey gives rise to new facts. Scientists disseminate the information by publishing the research results in journals etc. Table 4 provides a rough idea about the time taken for publication of research results in the pre-Internet era starting from the preparation of the paper to the publication of abstracts in secondary sources. The variable factors in this are editor's table, referee and the authors themselves. Sometimes the acknowledgement of the paper itself by the editor takes more than a month. Some referee's take more than three months to express their opinion about the paper. In many cases referees suggest some changes in the paper. For incorporating the changes authors may take from a month to several months. The publication of my papers in a foreign journal took about 18 months. The advent of Internet has reduced communication time considerably. Still the time for publication has not reduced very much. The editor of a famous LIS journal of our country recently stated that any paper received now will take about two years for publication in his journal because the papers already in hand for publication is huge and each issue of his journal cannot publish more than a fixed number of papers.

Table 4 – Flow speed of research results in the pre-Internet era.

Actions Involved	Duration in Weeks	Cumulative Total in Weeks
Preparation of the Paper	8	8
Postal communication (air mail)	1	9
Editor's table	3	12
Postal communication (air mail)	1	13
Referee	9	22

Postal communication (air mail)	1	23
Editor	3	26
Postal communication (air mail)	1	27
Author	5	32
Postal communication (air mail)	1	33
Editing	5	38
Printing including proof correction by the author	6	44
Publishing	4	48
Postal communication (sea mail)	6	54
Alerting services	2	56
Postal communication (sea mail)	6	62
Indexing services	12	74
Postal communication (sea mail)	6	80
Abstracting services	24	104
Postal communication (sea mail)	6	110

Purposive Flow

In many cases great efforts are exerted to spread information. Business houses spend millions of bucks to spread information about.

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Automatic Flow

For the flow of some type of information, effort is needed. Some other type flows without any effort. Let us take this example. In 1970s, my nephew, a resident of a Bihar village, purchased a TV. That was the first TV in the village. The news of TV spread like wild fire. And by the evening, the entire village and its neighbourhood knew that a TV had arrived in the village. In this case, the information spread without any effort.

Information Flow in Various Fields

Barriers to Information Flow

Information flow is not always smooth because of a number of **barriers**. A listing of the barriers is given below without attempting any detailed description because of paucity of time.

Library and Information Centres
Poor cataloguing, classification and shelving
Unqualified and inexperienced staff
Unhelpful attitude of the staff
Information explosion
Lack of bibliographical control
Lack of authenticity

Abundance of Literature and Redundancy

Literature even on a narrow subject is so much that it is difficult for a researcher to go through everything. Moreover there is a great deal of redundant literature.

Lateral Flow of Information

Information flow among the equal ranks, not from seniors to juniors, or from juniors to seniors

Communication

Postal – Takes time.

Telegraphic – Wrong telegram. For example, telegram sent to Upendra Chandra Pal, Jayanti Cooperative Society was typed as Upendra Cooperative Society. The telegram did not reach the destination.

Telephone -   Noise (cross talk, poor audibility, reflection of the voice, etc.)

E mail - Spam

Fax – Failure in transmission. Reaches wrong destination

> **Distance** - A person living close to a library has better access to information than a person living far away.

Poor presentation – If a presentation is full of jargons and difficult words, it is not understood by many.

> **Poor language of the speaker –** In an international conference there was two speakers from a particular Asian country. There English being very poor, we could not make out what they were saying.

Poor audio and video – This also hinders the comprehensibility of the information.

Internet

Inadequate knowledge of handling the search engines

Excessive number of hits (Searching a needle in a haystack)

Inefficiency of the search engine

Slow transmission

Lack of power supply

Fault of the server

Editorial process – Discussed in Table 4

Surrogation

It takes a long time for the appearance of abstracts in secondary services especially of difficult languages like Chinese, Japanese and Korean.

Psychological

Fear of the loss of monopoly, honour, attempt on life, etc.

Incapability of understanding (Einstein's theory of relativity is not comprehensible to all)

Misunderstanding

Religion

1616AD - Galileo Galilei supported the heliocentric theory in his publication "The Great Systems of the Universe" propounded by Copernicus. For this he was ordered by the Church to recant all that he had taught. During the last eight years of his life he was under house arrest for having "held and taught" the Copernican doctrine. He died on January 8, 1642 and he was pardoned by the Roman Catholic Church and Pope John Paul II in 1993 [12].

1859 AD - Theory of evolution. In many places the Christian Church has been successful in banning the textbooks containing the Theory of Evolution

Taboos and **Fatwas** also hinder the smooth flow of information.

Politics

1946 - Speech by Sir Winston Churchill at Westminster College in Fulton, Mo. "From Stettin in the Baltic to Trieste in the Adriatic, an iron curtain has descended across the Continent" [13].

Books on religion, Yoga and many other subjects were not allowed to be read in the USSR

Modern art was banned in USSR [14].

Books on Communism were banned in many countries

Church forbade the display of the human body in three-dimensional form

Finance

Poor financial condition of the communicator or receiver does not allow him to purchase newspapers etc. Difficulty of getting foreign exchange also hinders acquisition of foreign books.

Government

Many documents are marked by the government as confidential, secret, top secret and so on. They are not made public and termed as classified documents. These are made public when it is no more considered secret. For example, top secret correspondences between Churchill and Stalin during World War II have been made public some years ago, and they have been published.

Censorship

Definition - The act of examining printed materials, paintings and other artistic works, letters, motion pictures, radio programmes, TV programmes, etc. and to remove, destroy, or prohibit anything that is obscene, libelous or found objectionable from the political, religious, and moral point of view. In addition new knowledge, new political ideas, new religious thinking, new attitude towards sex, etc. have always been the subject of censorship.

Authorities
Religious Bodies
Government
Self-Appointed Guardians of Public Morality

Censor-prone Items
Printed Materials
Books [Index of Forbidden Books first published in 1559 was last issued in 1948 including about 4,000 books of all kinds].
Newspapers

Magazines
Pamphlets
Tracts (Short pieces of writing on moral or religious matter)
Posters (Containing obscene pictures)
Paintings and other works of art
Letters (Censoring in defence services and other places.)
Motion Pictures (U marked films, A marked films)
Radio and TV programmes
New Knowledge
New Ideas
New Religious Thinking
New Attitude towards Sex

Means of Imposition

Destruction [In 3rd century BC, Chinese emperor Shih Huang Ti, builder of the Great Wall, ordered the destruction of books to stop opposition in his kingdom. In the early years of Hitler's rule in Germany any book that did not receive government approval was thrown into fire.]

<u>Banning</u> - Prohibiting the sale and circulation of the book
<u>Licensing</u> - Prepublication censorship
<u>Prior Restraint</u> - Stopping the publication by legal means

Non-disclosure for retaining monopoly
Non-disclosure for fear of personal loss

Illiteracy – Illiterates remain vastly ignorant about the development in the world. They live with limited information they get people, radio or TV.

Language
Neologism (use of new words)
Numerous languages
Lack of translators and interpreters

Diffusion of information [15] has been studied in great detail in corporate sector and various models of diffusion has been presented. The models are epidemic model, economic theory model, stock adjustment model, etc.

The **epidemic model** is developed on the analogy of epidemic diseases. When information spreads very fast in all directions like an epidemic disease, the information diffusion is said to follow epidemic model.

The **economic theory model** relates to innovation. Information relating to a new innovation reaches the concerned firms by various means. The reactions of different firms to the new innovation is different. As a result the time elapses before adopting an innovation is likely to differ significantly amongst firms within the same industry. It seems the difference is related to the size of the firm.

The **stock adjustment model** was used in US and UK in 1960s and 1970s to study the stock levels of computer there as it helps to indicate the stock level. Even now it is used in the study and analysis of investment behaviour. It has been found to be particularly useful to study inter-organizational diffusion of information.

Measurability

The information is measurable. In information theory it is measured in terms of bits. Bibliometricians measure it in terms of documents, lines or words.

Information may be lost

Information get lost, specifically unrecorded information. Today if we are to asked to write the names of our forefathers of the last ten generations, most of us will not be able to do it, because the information is lost as they were not recorded. The Iron Pillar at Qutb Minar area was constructed more than 1600 hundred years ago. Till to it does not rust. How the material for its construction was prepared is not known today. The vital information is lost. Our modern technology has not yet been able to prepare such material comprising iron and other metals/non-metals that can remain rust-free for such a long time.

Information may be misinterpreted

A pathologist interpreted the patch in the left lung of a person as a case of advanced tuberculosis. Other pathological/clinical tests negated the interpretation. The patch was due to the accumulation of phlegm in the lung.

Information reinforces already known facts

 A researcher may claim the discovery of some facts. If further research finds out the same thing the information will be authenticated.

Information reduces uncertainty

 You are to fly tonight. A thick cloud of fog has already enveloped your city. You are unsure about the flight. You are supposed to start now for the airport. You call up the airport and are told that the flight will be delayed by at least three hours. Your uncertainty ends and feel relaxed.

Information cumulates

Since time immemorial, whatever information has survived, has cumulated. In 1907, *Chemical Abstracts* started with 11,847 abstracts. Now it publishes more than 1,000,000 abstracts a year. The entire information produced in the field of chemistry or in any other field has cumulated. Only unauthenticated information has found their way out.

Information has Value

Information has commercial value, that is why it can be priced and sold. This apart it has many other values. Some examples are given here according to areas:

Accidents and Disasters

 Information is disseminated all over the world about impending storms. Getting the information government takes action to evacuate people from the areas going to be affected. Sometimes people themselves take action to evade disaster.

Decision Making

 Without information, decision making is practically impossible. A government needs correct information for the purpose. A government decides about the import of food obtaining information about the food production in the country. If it is known that food produced in the country is insufficient to meet the requirement a government can decision easily to import food.

A research scholar when comes to know that work has already been done on the topic in which he is doing research, he can take a decision to modify or change his topic. If the researcher get the information early a great deal of his labour is saved.

INFORMATION - RELATIONSHIP WITH DATA AND KNOWLEDGE
Data itself contains some information. Huge amount of information is generated when data is processed. In a data sheet there may be 50 questions. In one datasheet filled in datasheet, there will be data/information about one individual, family, library, and so on. If data is collected from a sample of 100, then by processing the data, information will be generated basing all the 50 questions. Hence, it has been said that data is the raw material for information. On processing, the raw material generates information.

Information and knowledge has been discussed later on in this essay.

SCOPE
   Whatever has been expressed in any form and recorded in any medium since ancient times and will be expressed and recorded in future form the scope of information.

KNOWLEDGE
There are various definitions for knowledge. Some of them are presented below.

DEFINITIONS
1) The fact or condition of knowing something with familiarity gained through experience or association [2].

2) Acquaintance with or understanding of a science, art or technique [2].

3) The fact or condition of being aware of something [2].

4) The range of one's information or understanding [2].

5) The circumstance or condition of apprehending truth or fact through reasoning: COGNITION [2].

6) The fact or condition of having information or of being learned [2].

7) The sum of what is known: the body of truth, information, and principles acquired by mankind [2].

8. All that has been perceived or grasped by the mind; learning; enlightenment [5]

   Note: All the definitions given above are universal and not any subject specific. Moreover, they are not difficult to understand. All the definitions involve an individual, or a human being. The definitions clearly indicates knowledge is person-based.

CHARACTERISTICS

Communicability
Knowledge is communicated only through information.

Recordability

Knowledge is recorded in the brain where the method of recording is completely different from ours.

Condensability

Knowledge is not condensable. With the aging process some knowledge of an individual may be lost.

Expandability

Knowledge of an individual expands with the addition of new knowledge. When the knowledge of an individual is authenticated it expands the universe of knowledge.

Suppressibility

Knowledge of an individual cannot be suppressed. With the death of the individual his tacit knowledge is lost.

Repackagability

Knowledge of an individual cannot be repackaged.

Saleability

Knowledge can be sold. A magician knows many tricks. He can sell one or more of his tricks to another individual. By selling knowledge, a person does not loose his knowledge. A teacher also sells his knowledge since he is paid for his teaching i.e. disseminating his knowledge.

Usability

Knowledge is usable. Everybody uses knowledge.

Forgability

Knowledge cannot be forged. Some scientists like Lysenko tried to propagate fake knowledge. Finally, they were detected to be fake.

Fluidity

Knowledge flows through the vehicle of information.

Measurability

Knowledge is measured through the method of examinations, interviews, etc. The unit of measurement is marking or grading.

Knowledge may be lost

With the death of an individual, some amount of knowledge is lost. Even loss or destruction of documents leads to the loss of knowledge.

Knowledge cumulates

A child of two or three years possesses very little knowledge. As he grows up s/he starts gathering knowledge. His/her knowledge goes on cumulating till the end of his/her life.

Knowledge has value

It has already been pointed out that knowledge can be sold. That means it has commercial value. It has other values. In every sphere of our lives we use knowledge to gain something, circumvent difficulties, keep ourselves healthy, and so on. In this way it can be shown that knowledge has unlimited value.

INFORMATION AND KNOWLEDGE – COMPARISON

INFORMATION applies to facts told, read or communicated that may be unorganized and even unrelated [16].

  Note – By being told, communicated or by reading, an individual will definitely get information. However, it is not necessary that he will become thoroughly knowledgeable about what he has been told, communicated or he has read. For becoming knowledgeable one has to comprehend information. Let us take an example. A student while memorizing abbreviations learnt that QED stands for *quod erat demonstrandum*. He will have only this much of knowledge. He will not have any knowledge about the meaning of QED.

KNOWLEDGE is an organized body of information, or the comprehension and understanding consequent on having acquired and organised a body of facts [16].

  Note – The first part of the definition demands discussion. Let us take an example. Physicists have decided the constituent and structure of physics basing their knowledge of the subject. Accordingly books on physics have been written. A non-physicist will not be able to do it as he does not have the knowledge of the subject. Hence conceiving an organized body of information is only possible when one is highly knowledgeable in the subject. In other words, organized body of information is derived from the knowledge of the individuals.

KNOWLEDGE applies to facts or ideas acquired by study, investigation, observation, or experience [2].

Machlup's [17] distinction between information and knowledge is depicted in Table 5.

Table 5 – Distinction between Information and Knowledge

Information	Knowledge
It is piecemeal, fragmented, particular	It is structured, coherent, and often of enduring significance
It is timely, transitory, perhaps even ephemeral	It is a stock largely resulting from the flow and inputs of information
It is a flow of messages	It may affect the stock of knowledge by adding to it, restructuring it or by changing it in any way.

A comparison of information and knowledge is provided in Table 6 taking into accounts various characteristics of information and knowledge with the hope that it will make the distinction between information and knowledge clear.

Table 5 – Comparison of Information and Knowledge

Heading	Information	Knowledge
Carrier	Humans and other media	Humans and information
Communicability	Communicable	Communicable through information
Condensability	Condensable	Non-condensable
Definition	Facts or ideas told, read	Facts or ideas acquired by

	or communicated	study, investigation, observation, or experience
Expandability	Expandable	Non-expandable
Expressibility	Expressible	Expressible through information
Forgability	Forgable	Non-forgable
Growth in terms of volume	Very fast	Slow
Limit	Unlimited	Unlimited
Mental map	Affects, if understood	Affects
Misinterpretation	Possible	Possible
Organisation	Unorganized, scattered	Organised, consolidated, validated
Ownership	Universal	Personal
Possibility of loss	Yes	Yes
Raw material	Data	Information
Recordability	Recorded in some media (paper, film, magnetic disks, optical disks, papyrus, stone, etc.) with the aid of a language	Recorded primarily in the brain
Scope	Explicit knowledge	Explicit knowledge and implicit knowledge
Suppresibility	Generally non-suppressible	Non-suppressible
Translatability	Translatable	Knowledge that exists in the form of information is translatable
Units of measurement	words, lines, pages, documents, etc.	Marks and grades given in examinations
Usability	Usable	Usable

SCOPE
Whatever human beings have known since time immemorial till today and will know in the future forms the scope of knowledge.

CONCLUSION
An attempt has been made here to distinguish between information and knowledge. If we remember that information is stored in documents and knowledge in brains, it will be easy to distinguish between the two concepts. The confusion arises as explicit knowledge is embedded in information as butter in milk. It is to be remembered that information comprises only explicit knowledge, and knowledge comprises both explicit and tacit knowledge.

REFERENCES

1. Krishan Kumar. *Theory of Classification*. New Delhi: Vikas, 1979. x, 510p. Print.

2. WWWebster dictionary. Web.

3. Hypertext Webster Gateway. Web

4. Foskett D J. *Pathways for communication*. London: Clive Bingley, 1984. p4

5. Information. *Compton Reference Collection*. 1996. CD

6. Szymanski, Robert A; Szymanski, Donald P; Pulschen, Donna M. *Computers and Information Systems.* Upper Saddle River, NJ: Prentice Hall, 1995. p588.

7. *Encyclopedia of Computer Science and Engineering.* 2nd ed., 1983. p715-16

8. Bible. Wikipedia. Web <www.wikipedia.en.>. Viewed on 27 February 2012.

9. Wren P C, Martin H. *High School English Grammar and Composition*. 79th ed. Bombay: K & J Cooper, 1970. p596.

10. Kissinger regrets India comments. BBC News. Web. <http://www.bbc.co.uk/2/hi/ southasia/4€. Viewed on 27 February 2012.

11. Counterfeiting and forgery. *Compton's Concise Encyclopedia* **in** Compton's Reference Collection 1996. CD.

12. Galileo. *Compton's Concise Encyclopedia* **in** Compton's Reference Collection 1996. CD.

13. *Compton's Concise Encyclopedia* **in** Compton's Reference Collection 1996. CD.

14. Russia - Painting & Sculpture. *Compton's Concise Encyclopedia* **in** Compton's Reference Collection 1996. CD.

15. Satyanarayana, R. Information communication process. *IGNOU Course Material – MLI-101:Information, Communication and Society*. New Delhi: IGNOU, 2006. Print.

16. Urdang, Laurence; Berg, Stuart, Eds. *The Random House Dictionary of the English Language*. College ed. Bombay: Allied Pub., 1972. P. 684. Print.
17. Machlup, Fritz. The Production and Didtribution of Knowledge in the United States. 1962.