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DIGITAL REVOLUTION AND INFORMATION AGE: EMERGENCE OF ECONOMIES OF ATTENTION

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Abstract: Just as ‘industrial revolution’ ushered in the ‘industrial age’ in the eighteenth century, ‘information and digital revolution’ has steered the emergence of ‘information age’ in the middle of the twentieth century. The onset of the information age has been accompanied with the advent of a knowledge economy, comprising the quaternary and quinary sectors. Information age indicates the enhanced and growing significance of ‘information’ as the single most valuable commodity. Information is a factor of production, commanding a price. However, availability of ‘wealth of information’ at the disposal of consumers has created a peculiar situation of ‘information overload’, leading to ‘poverty of attention’. This has led to the emergence of ‘attention economy’, which treats information as an economic problem, and considers human attention as a scarce commodity. As the quantity of digital information increases, the level of human attention decreases. Information overload or clutter and limited capacity of humans to take this information leads to the psychological phenomenon of ‘selective attention’, ‘selective retention’, and ‘selective distortion’. Hence, the characteristics; and the media or internet habits of the target audience need to be researched, so as to identify their interest areas. Information can be provided or may be hyperlinked accordingly. Website designers are dealing with this tough job of creating attractive websites and storefronts, so that the audience, once visit such a site, spend a longer time there, and find it useful and user-friendly. The search engines should also invest their time and effort to analyse and judge whether a particular information is worthwhile, authentic, and not simply a repetition of what is already there. This will substantially reduce information overload will resolve the attention issue.

Keywords: *Digital Revolution, Information Age, Attention Economy, Quaternary and Quinary Sector, Selective Attention, Selective Retention, Selective, Distortion*

I INTRODUCTION

Since the emergence of the earliest hominids, the trajectory of technological, social, economic and political advancement of conscious (human) life on Earth, can be grouped into seven stages:

- 1) Hominid Age (7 million BC to 2.6 million BC)
- 2) Scavenging Age (2.6 million BC to 6,00,000 BC)
- 3) Hunting/Gathering Age (6,00,000 BC to 10,000 BC)
- 4) Horticultural Age (10,000 BC to 4000 BC)

5) Agrarian Age (4000 BC to 1700 AD)

6) Industrial Age (1700 AD to 1960 AD)

7) Information Age (1960 AD onwards, until at least 2030 AD)

The industrial age formally closed with the launch of the first satellite ‘Sputnik’ into the earth’s orbit in 1957. The contemporary information age began in 1960, and its earliest achievement was the lunar landing in 1969. Other notable milestones were more use of nuclear and space technologies. However, all this was possible due to a ‘digital revolution’, which changed the electronic

technology from the mechanical and analogue mode to the digital mode. This implied mass production and widespread use of digital and logical circuits and associated implements like computers, the internet and cellular phones. These have brought about far-reaching changes in computing and communication technologies.

The agricultural and industrial revolutions that contributed in generating new information were sometimes shaped by individual innovators, and some other time it is purely institutional. However, during this information and technological uprising or revolution, the different type of innovative, technical, and scientific activities are experiencing growth on a continuous basis which is also witnessing the co-terminus emergence of other activities that are information-oriented.

Thereafter, human history has witnessed, the Information Age or Period. Here, a shift happened towards an economy centred on information technology and computerisation, from the traditional smoke-stack industry based economy. Hence, this period is correlated with digital revolution as was the case of industrial revolution which is considered as the genesis of the industrial age [1, 2]. Continuous changes are happening in the sphere of technology with constant innovations taking place all over the world, new devices being invented and advance modifications happening in them every now and then. Take the example of devices like, smart phones and laptops – the technology is evolving and the rate of obsolescence is extremely high. Hence, in this new era and changing relationship between humans and technology, the definitions of terms like, information, digital technology all are not static rather are continuously evolving.

Another outcome of this age is the uprising of a knowledge-based society and a global economy which additionally high-tech in nature. The society is becoming extremely commercialised where individual needs are monitored and explored with the help of information technology, especially the Artificial Intelligence (AI) technology. All this has led to better decision-making and cost-effectiveness on the part of vendor as well as the buyer [3].

Beside the AI technology, the advance technology being used in micro-miniaturization of computers has all the more helped in day-to-day life of average individual with modernised communication and information processes and user friendly devices. Also it has helped the product marketers and service providers to reap in the benefits of information age in providing better services and increase their market share. All these has been the dynamic force behind the development of society or the social evolution [4].

II REVIEW OF LITERATURE

Information revolution designates the changing trends in the economic, social and technological environment. These trends spawned much after the industrial revolution. The different viewpoints regarding this has been summarised in the following paragraphs.

Bernal elaborated on the new role that science and technology will play in the society. He described it as the ‘scientific and technical revolution’ [5]. He proclaimed science as a productive force, relying on the Marxian Productive Forces theory. The then thinkers and essayists of the Soviet Bloc vouched on the theory that Scientific and Technical or technological Revolution (STR) can survive only under socialism, as is visible in a book by Richta of Czechoslovakia [6]. However, Bell did not agree with this theory, and he propounded a post-industrial society, and visualised an evolution of a service economy rather than the socialist economy [7]. Several authors presented their views, including Zbigniew Brzezinski about “Technetronic Society” [8].

The 1940s witnessed many works in the field of new sciences, with ‘information’ being the prevailing theme like that of Wiener [9] and Shannon and Weaver [10]. Wiener’s aphorism “information is information, not matter or energy”, proposes the third constituent of the Universe consisting predominantly of information along with matter and energy. According to him, information is carried either by matter or by energy or by both. But the viewpoints of several writers changed by 1990s. Now, they predicted that this information revolution may lead to huge changes in working which will ultimately result in a fiscal crisis for governments coupled with the breakdown of prevailing “super structures”. Porat applied the input-output analysis in order to measure the dimension of information sector in the US. They found that the Organisation for Economic Co-operation and Development (OECD) has begun to include statistics on information sector in the economic reports of its member countries [11]. Veneris developed a system dynamics simulation computer model applying the theoretical, economic and regional characteristics of the information revolution [12, 13].

Machlup claimed that “knowledge industry represents 29% of the US gross national product”, which in turn indicated that the “Information Age” has commenced [14]. He propounded commodity concept of knowledge by measuring the extent of production and distribution of knowledge as a commodity within an economy. He further allocated the use of information into three areas: instrumental, intellectual, and pastime knowledge. On the

basis of his study he categorised knowledge into following types;

- (i) **Practical** knowledge
- (ii) **Intellectual** knowledge that gratifies intellectual curiosity
- (iii) Pastime knowledge, that serves the longing for entertainment and emotional stimulation
- (iv) **Spiritual** or Religious knowledge
- (v) **Unwanted** knowledge unintentionally learnt and retained without any purpose.

Hilbert and Lopez estimated the growth in technological capacity of the world from 1986 to 2007:

- Capacity to obtain information by broadcast networks grew by 7 percent.
- Capacity to store information increased by 25 percent.
- Capacity to exchange information grew by 30 percent.
- Capacity to compute information with computers increased by 61 percent [15].

III OBJECTIVES

The availability of ‘wealth of information’ at the disposal of consumers has created a peculiar situation of ‘information overload’, leading to ‘poverty of attention’. This has led to the emergence of ‘attention economy’, which treats information as an economic problem, and considers human attention as a scarce commodity. The present study seeks to understand the problems associated with attention economy and explores the ways to deal with it, and aims the following:

- 1.To review the economic dimensions of ‘information’.
- 2.To appraise the relationship between (digital) information and (human) attention.
- 3.To evaluate the issue of information overload, identify possible sources and explore solutions.
- 4.To examine the emergence of the attention economy, and assess its applications.

IV METHDOLOGY

Secondary sources formed the bases of the study. This included books, journals, newspaper articles, research reports, and websites. However, people’s view (through a variety of primary survey tools) on information overload were obtained, in order to determine the techniques they employ to overcome and negotiate the issue of information overload on a day-to-day basis, as the ‘problem’ has become rampant in the contemporary period.

V RESULTS

The outcome of the study is divided into four paragraphs, which are as follows:

Economic Dimensions of Information

This was based on the outcome of the study by Veneris [16]. He explained the fundamentals of the information revolution, from which following economic dimensions of ‘information’ are deciphered:

- 1.Economic activities result from the interaction between matter, energy, and information. For example, ‘iron’ is a matter which may be processed by the industry and for that purpose, the industry will use energy and technologies like production and process technologies, management, etc., in other words, information.
 - 2.‘Information’ is both, a factor of production as well as a product or commodity, traded at the market. Information has a ‘price’, as it has both, a ‘use value’ and ‘exchange value’.
 - 3.The informational value of a product is determined by its information content, innovation and design.
 - 4.Industries nurture information-generating functions, or the Research and Development (R&D) activities.
 - 5.Organizations encourage information control and processing functions, through managerial and bureaucratic structures.
 6. Labor is classified according to the purpose – information labor (intellectual power) and physical labor (muscle power).
 - 7.Information activities constitute an emerging new sector of the economy, the information sector (subdivided into quaternary and quinary sector), existing with the traditional sectors, i.e., the primary, secondary, and tertiary sectors [17].
 - 8.Sectors may be re-classified into production, consumption and information sector. Marx had stressed on the role of “intellectual element” in production, though did not mention in his model.
 - 9.Innovations, in the form of fresh products, methods of production and patents, results from new information.
- Fang [18] identified five stages of ‘information revolution’ – writing, printing, mass media, entertainment, ‘tool shed’ (‘Home’) and the information highway. This describes the trends in communication media, though the theory has been criticized for being narrow in outlook.

Relationship between (Digital) Information and (Human) Attention

The relationship between digital information and human attention is inversely proportional as shown in Figure

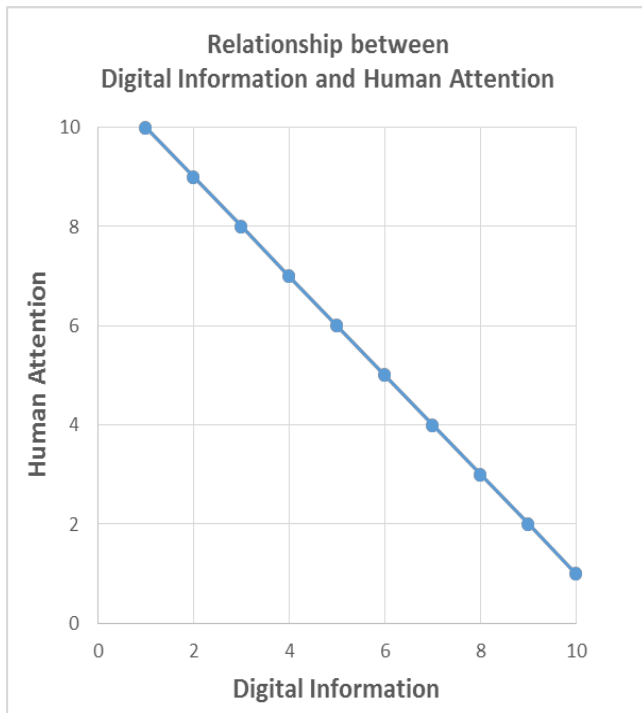


Figure 1: Relationship between Digital Information and Human Attention

As the quantity of digital information increases, the level of human attention decreases. This phenomenon is associated with the factors like, information overload, distractions, and selective attention. Too many information and most of the time, unnecessary information is bombarded at the audience, while the human brain has limited capability to process all the information available and make sense out of it. Besides that, the psychological phenomenon of ‘selective attention’, ‘selective retention’, and ‘selective distortion’ starts working, in the presence of a clutter.

Selective attention is a psychological process of reacting to a certain stimulus selectively in the presence of too many stimuli. Hence, the individual focuses on a particular information or object and weed out unimportant ones. For example, if you are looking for a new laptop, you will focus attention on all advertisements and news related to laptops and will not probably, notice advertisements of any other product.

Selective retention is another psychological process whereby people stick to their interests, values, and beliefs, while processing any information, and hence, will remember only those information which confirms to their interests, values and beliefs; and shun away from the

information which do not confirm to their value or belief and interest system. Coupled with selective retention is the problem of ‘selective distortion’, i.e. there is a tendency among people to change or twist the information when it does not confirm to their personal interests, feelings, beliefs or values.

Advertisers are trying hard to deal with the clutter, and the associated psychological phenomenon. Hence, in earlier times, when the entire newspaper or magazine used to be black and white, there was this one advertisement which was printed coloured and getting all the attention. Reverse is the case now, that is, in the clutter of all coloured print or audio-visual advertisements, one black and white advertisement catches our attention. Similar rules apply in case of digital information as well, and the website designers are coping with all these.

Though the world has been considered as information-rich, poverty of attention is created by this very wealth of information [19]. Thus ‘information overload’ is an economic problem, and ‘human attention’ is a scarce commodity.

Since attention scarcity is misunderstood as information scarcity; designers of information system make the systems more efficient, thereby providing more information that is further irrelevant, unrelated and insignificant [20].

Information Overload

Information overload is a situation, when an individual has difficulty to understand an issue or make an effective decision, due to an availability of too much information related to the issue. Bertram Gross [21] coined the term, while futurist Alvin Toffler [22] popularized it. Today, a variety of metaphors, similes and analogies are used to describe the condition of information overload – infobesity, infoxication, information glut, data smog, etc.

If the processing capacity of a system is surpassed by the quantity of input infused in the system, this may result in an information overload. The decision-making process actually slows down in such a situation and the quality of decisions also suffers. After all, the cognitive processing capacity of decision-makers is limited, and information overload hampers the process of decision-making or rather the quality of decision-making.

Further, the modern day technology enhanced substantially the quantity of information produced, the ease of its distribution, and the extensiveness of the audience reached. These are the driving force for information overload. Social media has further augmented the problem.

Scholars disagree on this issue. For example, according to Shirky [23] “It’s not information overload, its filter failure”.

The sources of information overload are enumerated below:

1. **E-mail** – It is the largest source of information overload. Users and subscribers have to struggle, not only to filter-out unwanted commercial messages (spam), files and documents attached, and heavy images and multi-media files.

2. **The Internet or World Wide Web and Search Engines** – It offers access to billions of pages of information (equivalent to several trillion of bytes of digital information). In many homes and offices, people have unrestricted access to the internet. The search engines of different web platforms helps subscribers to search for relevant information swiftly. But this type of information available on the web is always questionable in terms of its reliability and accuracy, and ultimately its quality. Hence, extreme pruning, cross-checking, and processing of such information is required. Then only it can be of any use for the purposes of decision-making. This type of information processing can prove to be a time consuming and costly affair. Beside that a huge amount of web resources are available on one particular topic which can't be processed by single human brain. Hence, organizations have a full-fledged Management Information System (MIS) to process and streamline the information.

3. **Journalism of Assertion** – One can witness the poor quality of news reporting in different media, be it the audio-visual, or print, or social media. The channels have to transmit news continuously and also come out with breaking news every now and then, for gaining the competitive advantage. This calls for an acceleration in the generation of information and a deterioration of news quality.

4. **Incoming Information** – The modes of communication has multiplied over the years, like, telephone or smart phones, e-mails, instant messaging, and so on. This further adds to information overload and sometimes generation of fake news and stories.

Another term analogous to information overload is information explosion, which is a stage before information overload. Information explosion is the rapid increase in published data and information, which when difficult to manage leads to information overload.

One of the adverse effects of the information revolution is information pollution, which is contamination and adulteration of information reserve with irrelevant, redundant, unsolicited and low-value information that is not only useless and undesirable but also has a detrimental effect on human and their economic activities.

Attention Economy

Attention economics is methodology to information management that treats human attention as a rare commodity. Economics theory is applied to solve different problems of managing information. “Attention is focused mental engagement on a particular item of information. Items come into our awareness, we attend to it, and then we decide whether to act” [24].

With information becoming abundant and instantaneously available, attention is the limiting factor in consumption of this information. Humans with their limited mental ability, fail to process all the information as they have a limited receptivity too. The human brain uses ‘attention’ to filter out significant and noteworthy information, from a large pool of available digital information. If a software application takes too long to locate a piece of information, then the consumer will find it through another application (search engine), which ensures that the user has access to the most relevant information.

Several economists like Gold Haber (1997) and Franck (1999) have speculated that “attention transactions” will substitute financial transactions as the center of our economic system. Researchers on information systems have also adopted this notion, and have already started investigating the mechanism and designs to build property rights.

VI DISCUSSION

Attention Economy has significant application in advertising. As there is an overload of information or advertisements, consumers pay less attention on any particular information. “Attention economics” considers it as a challenge and contemplates potential consumer's attention as a resource. Potential consumers follow the linear AIDA Model – Attention, Interest, Desire and Action; Attention being the first stage of the model, the first aim of the advertiser is to catch the attention of the non-consumers and converting them to be as attention seekers. Hence, consumer's attention is an important and a scarce resource, now-a-days, in the presence of innumerable advertisements and attention drifters. Moreover, all this information and advertisements are available to the consumers at a very low cost due to multiplicity of media and also due to the low cost online advertising.

Kelly [25], an expert on digital culture, explained the current attention economy. He felt that reproducing the consumer product costs less, but valuable intangibles have to be added to the product by the supplier, like:

1. Customization or personalization

2. Immediacy or immediate delivery
3. Authenticity or genuine product
4. Accessibility anytime, anywhere
5. Patronage or "paying simply because it feels good",
6. Fundability or "there are millions of books, songs, films, applications, etc. — and most of it is free, then being found is valuable".

Dolgin [26] states that super-fluidity of information hinders decision-making of an individual, who continues to search and compare products. Institutes, individuals, and companies, are spending a huge amount of money in devising ways and means to catch the attention of the targeted audience; to be different from the competitors who are also striving for the attention of the audience; and to emerge out of the clutter. The characteristics and habits of the target audience need to be researched well, so as to identify their interest areas and the specific information they are looking for. Also, the media and internet habits of the target audience should be specifically studied, to find out the sites they visit frequently, their search histories, the time and frequency of their visits, etc., so that the company or institute can get their websites hyperlinked to those popular sites. But then, this give rise to privacy issue and ethical issues, which are becoming all the more important in this information age.

Website designers are dealing with this tough job of creating attractive websites and storefronts, so that the audience, once visit such a site, they spend a longer time there and find it useful and user-friendly. Remember, this will increase the marketability or commerciality, market worth and reputation of the site, and obviously it will be easier for the site to sell their advertising space and generate revenues. Hence, out-of-the-box thinking is desired for website designing.

The search engines on their part, should also invest their time and effort to analyse and judge whether a particular information is worthwhile, authentic, and not simply a repetition of what is already there. Hence, sorting, discarding, processing, and classifying of information, a kind of Management Information System (MIS) needs to be built by the search engine companies. This will substantially reduce information overload will resolve the attention issue as well. In order to catch the attention of the target audiences, the website designers and the digital information providers will also have to tackle the psychological problems of 'selective attention', 'selective retention', and 'selective distortion', in the presence of a large number of competitors, several stimuli and the resultant clutter.

VII CONCLUSION

The information age is likely to last until 2030 AD, and today in 2017 AD we have thirteen more years to go. The information age will eventually give way to the nano-technology age that is likely to last until 2300 AD, which in turn will be followed by the quantum age until 15,000 AD.

As we proceed further, digital and computer-based occupations and services will be the order of the day, and incidents of cyber-crimes and cyber wars will rise. The resolution, speed, and visual displays of personal computers, laptops, and smart phones are all improving at a fast pace, while their sizes are all decreasing which can be a technological bliss to the mankind on one hand, and a means for crimes and destruction on the other.

Business transactions have taken a new shape with transactions taking place between a humans and virtual personality. Who could have imagined the value of cryptocurrency, which has only a virtual existence, could be a matter of debate and an asset of pride possession. The pandemic Covid-19 has opened up new vistas for technology based transactions in all sphere. Though traditional classroom remains, intelligent courseware will emerge as a common means of learning. Primary disabilities will not be handicap due to reading, listening and translating machines. Bio-engineered treatments for critical diseases will significantly reduce the mortality rate. Automated driving systems will be installed in most land and air-based transportation systems.

People may develop relationships with automated personalities replacing companions, teachers, caretakers, and lovers. Virtual artists and cyber-musicians will emerge in all fields of arts. This may adversely affect human employment in different sectors with machines and technology replacing them. But the need for techno-based education and manpower will of course increase manifold in near future. Soon, computers may become a legal person and have legal rights.

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BIOGRAPHY



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