Ibersid

revista de sistemas
de información y documentación

journal of information
and documentation systems

Ibersid
2012

revista de sistemas
de información y documentación

journal of information
and documentation systems

ISSN 1888-0967

Editor

Francisco Javier García Marco

Los artículos publicados están sometidos a evaluación científica y editorial en beneficio de la comunidad científica y los autores, pero dicha evaluación se realiza dentro de los límites del desarrollo actual de la disciplina, las limitaciones humanas de editores y revisores, y con una perspectiva ideológica, teórica y metodológica abierta, por lo que la dirección no siempre comparte las opiniones, métodos y procedimientos reflejados en la revista. Los autores se responsabilizan personalmente del cumplimiento de los códigos éticos y la legislación vigente, así como de la obtención de los permisos de copia de materiales ajenos.

ISSN: 1888-0967= Ibersid (Zaragoza)

Depósito legal: Z-2999-2007

Edita: Ibersid® con la colaboración de Prensas Universitarias de Zaragoza

Diseño de portada: David Guirao
Revisión de textos en portugués: João Batista Ernesto de Moraes

Imprime:
Servicio de Publicaciones. Universidad de Zaragoza.
Edificio de Ciencias Geológicas, C/ Pedro Cerbuna, 12.
50009 Zaragoza, España. Tel.: 976 761 330. Fax: 976 761 063.

Ibersid
revista de sistemas de información y documentación

Alcance y objetivos

Ibersid: revista internacional de sistemas de información y documentación es una publicación anual arbitrada dedicada a la gestión de la información y el conocimiento desde una óptica sistémica e interdisciplinar. Es el órgano de comunicación de Ibersid, una red internacional con presencia en África, América y Europa, que tiene su sede en Zaragoza (España), y que celebra congresos anuales (http://www.ibersid.org). Las políticas de aceptación y evaluación de originales se detallan en sendos documentos al final del volumen.

Difusión

Ibersid tiene difusión internacional. Al ser este el cuarto número, está en trámite la inclusión en las principales bases de datos de su especialidad. Está indizado en LISTA y Dialnet.

Reconocimientos

Ibersid publica en este volumen ponencias y comunicaciones arbitradas presentadas en la edición de 2012 del congreso Ibersid, que contó con ayudas del Vicerrectorado de Investigación de la Universidad de Zaragoza, el Ministerio de Educación y Ciencia, presentándose resultados del proyecto Infoscopos (CSO2009-07619) y la Cátedra Logisman de la Universidad de Zaragoza.

Redacción, distribución y canje

Revista Ibersid
Departamento de Ciencias de la Documentación e Historia de la Ciencia
Facultad de Filosofía y Letras
Universidad de Zaragoza
C/ Pedro Cerbuna 12,
E-50.009 Zaragoza (Spain)

Tfno: int + 34 976 762239. Fax: 34 976761506.
E-mail: ibersid@unizar.es

Suscripciones y números sueltos

Suscripción anual / Annual subscription: 30 €.
Número suelto / Volume: 36 €.
(IVA y gastos de envío incluidos).

Ibersid
journal of information and documentation systems

Scope and aims

Ibersid: an international journal on information and documentation systems is an annual arbitred international journal devoted to information and knowledge management from a systemic and interdisciplinary perspective. It is the scientific communication tool of Ibersid, an international network with presence in Africa, America and Europe, whose office is in Zaragoza (Spain), where it organizes its annual conferences (http://www.ibersid.og). Acceptance and evaluation policies are detailed at the end of the volume.

Dissemination

Ibersid has international distribution. Being its fourth number, its inclusion in the main reference databases is being negotiated. It is referred in LISTA and Dialnet.

Acknowledgments

In this volume, *Ibersid* publishes referred invited and contributed papers to the congress Ibersid 2012, which received grants from Ministry of Education and Science and of the Research Vice Rectorate of the University of Zaragoza. They correspond to activities of the project Infoscopos (CSO2009-07619) and the Catedra Logisman (University of Saragossa).

Contact address

Revista Ibersid
Departamento de Ciencias de la Documentación e Historia de la Ciencia
Facultad de Filosofía y Letras
Universidad de Zaragoza
C/ Pedro Cerbuna 12,
E-50.009 Zaragoza (Spain)

Tel.: int + 34 976 762239. Fax: 34 976761506.
E-mail: ibersid@unizar.es

Subscriptions

Annual subscription: 30 €.
Volume: 36 €.
(VAT and mailing expenses included)

Revisores externos del número / External reviewers in this issue

Agradecemos su colaboración a María Luisa Alvite Díaz, José Antonio Cordón García, Bárbara Fadel Montserrat García Alsina, Raquel Gómez Díaz, Carlos Olmeda Gómez, Rodrigo Rabello, Elsa Ramírez Leyva, Joaquín López del Ramo, Aires Rover, Juan Miguel Sánchez Vigil, Juan Francisco Torregrosa Carmona, Sonia Troitiño Rodríguez y Agustín Vivas Moreno.

Candidaturas al consejo científico

Se aceptan candidaturas al consejo científico de especialistas del área de Biblioteconomía y Documentación y de otras disciplinas relacionadas (Informática, Ciencias Sociales, Lingüística, Filosofía, Psicología, etc.) con experiencia profesional e investigadora demostrada. En el sistema público de investigación español, suele ser equivalente al doctorado y dos sexenios de investigación o méritos equivalentes.

Scientific council membership policy

Candidatures of researchers from LIS and other related disciplines (Computer Science, Social Sciences, Linguistics, Philosophy, Psychology, etc.) with demonstrated professional and research experience are welcomed. In the Spanish public research system, for example, this usually means having a doctorate and two scientific productivity sexennia or equivalent outputs.

Tabla de contenidos en español

Table of contents in Spanish

Tabla de contenidos en inglés

Table of contents in English

Mirando hacia atrás, escudriñando el futuro

Looking back, peering forward

Alan GILCHRIST

Cura Consortium and Metataxis Ltd.
alangilchrist77@gmail.com

Resumen

Se proporciona una mirada calidoscópica a la breve historia de la evolución de las tecnologías de la información y la comunicación. Se atiende a los aspectos conflictivos del impacto de estas tecnologías en la sociedad. Y se concluye con algunas sugerencias generales sobre los roles potenciales de los "nuevos" bibliotecarios y los redefinidos "científicos de la información".

Palabras clave: Tecnologías de la información y la comunicación. Impacto social. Ciencia de la información. Profesionales de la información. Historia.

Abstract

A kaleidoscopic look at a brief history of the evolution of information and communication technologies; followed by conflicting aspects of the impact of these technologies on people in general, concluding with some broad suggestions regarding the potential roles of the "new" librarians and the redefined "information scientists".

Keywords: Information and communication technologies. Social impact. Information science. Information professionals. History.

1. Introduction

The "Information Revolution" has been predicted for some time, but there is no doubt that we are now in a period of accelerating development of that concept which is bewildering in its details, but from which it is difficult to predict the future. Since the various communication technologies were added to the already powerful computing base we are now grappling with universal connectivity, speed of connection, and the vast scope of the World Wide Web; but with such rapid developments we are also faced with ambiguity and uncertainty.

This is not an academic paper, more an anthology of brief and scattered observations looking back at how we arrived at where we are today and peering – very tentatively – into the near future. I started information work in 1960, so I can claim to have spanned a period in information processing from manual to computerised methods – and also to recognize that I am now too old to take an active part in the new technologies; and in this I am not alone. There was a brief report in a British newspaper recently (Hopkins, 2012) quoting a General Shaw, Head of Cybersecurity at the U.K. Ministry of Defence, concerned about the hacking of military databases. He complained that "my generation...we are far too old for this. It is not what we have grown up with. Our natural recourse is to reach for a pen and paper...we really have to listen to the kids out in the street. They are telling us what is happening out there." More formally, Carr (2008) has stated "All technological change is generational change. The full power and consequence of a new technology are unleashed only when those who have grown up with it become adults and begin to push their outdated parents to the margins. As the older generation die, they take with them their knowledge of what was lost when the new technology arrived, and only the sense of what was gained remains. It's in this way that progress covers its tracks, perpetually refreshing the illusion that where we are is where we were meant to be."

2. A brief history of Information and Communication Technologies

Gaur, in her book on the history of writing (Gaur, 1992), said "All writing is information storage", and she includes all forms of record – clay tablets, papyrus scrolls, knotted cords and electronic media in this definition. In the Western world the most significant advance in writing was the Sumerian "invention" of the cuneiform script developed around 2600 BCE incised on clay tablets, many of which have survived to the present day.. At first, in awe of the power of writing, only the priests and the king were allowed to write but its obvious use in trade overcame this limitation. Indeed, the importance of writing for trade led to the development of an alphabet by those premier traders, the Phoenicians who, dealing in exports and imports across the Mediterranean principally between 1200 ad 500 BCE, needed a common standard of communication. Including various minor and major modifications (such as Cyrillic and Hebrew) it is this alphabet that is widely used today.

Though there is evidence of the ability to count and record numbers some thousands of years ago, the development of our modern numeral system is far more recent. It was not till the 10th Century that the Arabs, in what is known as “The Golden Age of Islam” started to develop a new notation with positional values; and through trading in India refined their ideas into the Hindu-Arabic system used today. Europe, though, was slow to catch on to this system which, though known about by a few scholars, was not fully explained till Fibonacci wrote his treatise on the system in the 13th Century. Consequently, churches were built in the 12th Century by stone masons conversant with the new system but were paid by the bishops recording the payments in Latin numerals. The two ‘technologies’ co-existed for a considerable length of time.

Perhaps one of the strangest examples of the slow take-up of a new technology concerns the invention of paper by the Chinese around the beginning of the 1st Century CE. The Middle East had started with clay tablets in Mesopotamia before the Egyptians cropped their plentiful reeds to make papyrus. Then, jealous of the expanding library of the Greek city Pergamum in modern day Turkey they banned the export of papyrus, whereupon Pergamum developed parchment (named after the city) made from the hides of calves. Due to Chinese secrecy paper was slow to start its journey along the Silk Route, but even then it was nearly 700 years before it arrived in Baghdad which, beginning to support a thriving academic revolution, established paper-making mills. Although Spain was importing paper in the mid 900s, it was a further 350 years before a paper-mill was established in Xàtiva (in the Province of Valencia) to supply the international communities of scholars in Toledo and Cordoba. Eventually paper-making arrived in Germany a hundred years before Gutenberg set up his printing press in 1439; reaching London in 1494.

It may seem perverse to jump across the Industrial Revolution from the printing press to the telephone, but this brief chronology is mainly concerned with information and communication technologies. It seems that the advent of the telephone in 1876 was something of a shock and not immediately appreciated. Thus, Mr. William Preece (later Sir William Preece) of the Post Office Engineering staff, when asked whether the telephone would be an instrument of the future which would be largely taken up by the public, replied “I think not”. Questioned further he said “I fancy the descriptions we get of its use in America are a little exaggerated; but there are conditions in America which necessitate the use of instruments of this kind more than here. Here we have a superabundance of messengers, errand boys, and things of that kind.” (Freshwater, 2010).

China CE	*105*
Samarkand	751
Baghdad	793 (?)
Cairo	c. 900
Fes	c. 1100
Xàtiva	c. 1150
Cologne	1338 (?)
UK	1494

Table I. The movement of the invention of paper and paper-making

And then came the digital computer in 1946, and here too the future was drastically miscalculated – first by none other than James Watson the Chairman of IBM who said in 1943 “I think there is a world market for maybe five computers.” This was followed by the Editor in charge of business books for Prentice Hall who said in 1957: “I have traveled the length and breadth of this country and talked with the best people, and I can assure you that data processing is a fad that won’t last out the year.” Twenty years later, Ken Olson, President, Chairman and Founder of the Digital Equipment Corporation opined: “There is no reason anyone would want a computer in their home.” (Stoddard, s. d.).

Despite these negative predictions which, with the benefit of hindsight seem oddly bizarre, computers and their applications burgeoned. By 1974 (three years before the third quotation above) the Internet arrived, followed in 1991 by the World Wide Web and in the same year the cellular phone; and in the last five years we have seen the spectacular rise in mobile computing with the iPhone and the iPad. Table II summarizes the spread and rapid growth of information and communication technologies. Table III presents a few statistics relating to their use.

Writing	*c. 2600 BCE*
Alphabet	c. 1000
Paper-making in China	105 CE
Hindu-Arabic numerals	c. 1000
Paper-making in the West	1150
Printing	1439
Telephone	1876
Digital computer	1946
Internet	1974
World Wide Web	1991
Digital cellular phone	1991
1Phone	2007
iPad	2010

Table II. A brief chronology of information and communication technologies.

To highlight the time spans in Table II, it can be seen that 3076 years elapsed between the invention of writing and the printing press compared with 134 years between the digital computer and the iPad. It is highly likely that the next 100 years will see advances in these technologies that are hard to imagine, particularly in their social impacts.

Number of computers	It is estimated that there will be more than two billion personal computers in use in 2015. Therefore, whereas it took 27 years to reach the one billion mark, it will take only 7 to grow from 1 billion to 2 billion (Forrester)	Worldometers, 2012
Number of cellular phones	5.6 billion in 2011, i.e. c. 70% of the world's population	Wikipedia contributors, 2012b
Number of email users	Worldwide – 1.88 billion Share of email accounts that are corporate – 25%	Pingdom, 2011
Number of emails sent	In 2010 – 107 trillion Average per day – 294 billion	Pingdom, 2011
Number of Internet users	Internet users (Dec 31, 2000): 360,985,492 (Dec 31, 2011): 2,267,233,742 World population (2011estimate) Penetration 32.7% Growth over period 2000-2011: 528.1%	Miniwatts Marketing Group, 2012
Size of World Wide Web	9.1 billion pages (15 May 2012) [e]	Kunder, 2012
Size of "Invisible Web"	500 times greater than the Google Index, when that contained 1 billion pages (now 9 billion - see previous entry) [f]	OEDB, 2012
Speed of search by Google	385,000,000 pages in 0.2 seconds	Rosenthal, 2012
Social media	People on Twitter 2010 – 175 million People on Facebook 2010 – 600 million	Pingdom, 2011
Videos and images	Number of videos watched per day on YouTube – 2 billion Number of videos watched per day on Facebook – 2+ billion Photos hosted by Flickr – 5 billion	Pingdom, 2011

Table III. A few statistics relating to information and communication technologies

3. A brief and personal history of Information Retrieval

My first job in information work was in 1960 when I joined the Library and Information Department of a large food processing company, providing a service to scientists and technologists, personnel in sales and marketing and all the support functions. One of my tasks was to catalogue the stock with the Universal Decimal Classification, using a manual typewriter. After four years I joined the Research Department of Aslib, an organization with a wide corporate membership and with its research funded, at that time, by government. I became Secretary to what was known as the "Co-ordinate Indexing Group", consisting of senior members of the information profession working in large industrial firms such as Imperial Chemical Industries and Royal Dutch Shell. It seems unbelievable now, but information retrieval in these firms was effected using hand-punched cards. These were of two types; the first, called an edge-notch card, being a card representing an item and having usually 75 holes ready punched around its edge. Each hole then had a subject allocated to it so that a card having subjects denoted at holes 15, 23 and 66, say, would have its holes clipped to the edge so that a needle passed through a pack of these cards caused ‘relevant’ cards to drop from the pack. The other type of card, called a ‘feature card’ inverted this process by having each card represent a subject; the card was divided into a grid of numbered squares, typically 1000, and the number of an indexed item was drilled at the corresponding square. Placing a number of cards representing subjects, typically three, on a light box enabled the searcher to retrieve those items where light shone through the drilled holes. This latter method was supported by a vocabulary of terms of usually no more than a few hundred terms, often between 100 and 200 (compare this to the more than 26,000 terms in MeSH, supported by over 177,000 entry terms).

During my 13 years with Aslib an IBM card sorter was bought using 80-column Hollerith cards, thus mechanizing the edge-notched card principle noted above; while early use of computers for information retrieval arrived in the UK. These early computers used Boolean searching which involved the composition of complex strings using AND, NOT and OR with ‘nesting’. (At the simplest level, note that A AND {B OR C} is not the same as {A AND B} OR C). The queries were then run in overnight batches, and any small errors in the placing of nests led to totally irrelevant results and the search needing to be run again the next night. Then came a new generation of text retrieval software, interestingly, in the UK, developed and sold by industrial organizations such as Imperial Chemical Industries (mentioned above and one of the first to develop hand-drilled feature cards) and research associations such as Harwell, a nuclear energy laboratory. Their software allowed online interrogation of an inverted file in alphabetical order of all the words in the text (initially abstracts only) using Boolean operators and often a thesaurus compiled by the customer. It was not long before software specialists arrived to cash in on a growing industry, and new search tricks which now seem primitive were developed, including search by word order, phrase, and word proximity. Till then, searching was conducted by intermediaries on behalf of end users, information scientists often attached to research teams; but distributed processing allowing end users to conduct their own searches created a revolution, and may be seen in retrospect as the first step in the wider aspects of disintermediation. The early text retrieval systems were based on statistical analysis of probabilities, a technique developed by the 19th Century English mathematician George Boole. Since then, more complex mathematical techniques have been used, including Vector Space Modelling, which places text words in a hypercube, measuring the distances and directions between them, and then matching the model against search terms. Currently, still at the research stage, work is being undertaken on the possibility of applying quantum theory and Hilbert spaces to information retrieval. (I asked an expert in the mathematics of text retrieval if this approach seemed promising and he admitted that he didn’t understand it). At the same time as mathematical techniques have evolved, much work has been undertaken in linguistic analysis and many of the results have been used, usually in conjunction with statistical analysis.

It would seem that many of these mathematical and linguistic techniques are being used by Google, backed by truly enormous computer power. In the city of The Dalles in the State of Oregon in the USA, Google has built a unique complex housing tens of thousands of custom-built servers; linked to each other and the whole complex linked to five other data centres around the world. In its database, Google maintains a copy of the visible Web, regularly updated and searched by “spidering” software scanning the billions of pages it discovers. According to Carr (2008),

> A set of secret algorithms analyzes all the pages to create a comprehensive index to the Web, with every page ranked according to its relevance to particular keywords. The index is then replicated in each cluster. When a person enters a keyword into Google’s search engine, the software routes the search to one of the clusters, where it is reviewed simultaneously by hundreds or thousands of servers […] comparing the keyword to a small portion of the entire index – what Google calls an index shard.

Carr goes on to report that: “According to Google engineers a typical search requires tens of billions of microprocessor cycles and the reading of hundreds of megabytes of data”.

In 2011, James Gleick (2011) interviewed Google’s founders Sergey Brin and Larry Page, recording this extraordinary exchange:

> “It will be included in people’s brains,” said Page. “When you think about something and don’t really know much about it, you will automatically get information.”
>
> “That’s true,” said Brin. “Ultimately I view Google as a way to augment your brain with the knowledge of the world. Right now you go into your computer and type a phrase, but you can imagine that it could be easier in the future, that you can have just

> devices you talk into, or you can have computers that pay attention to what's going on around them…" […] Page said, "Eventually you'll have the implant, where if you think about a fact, it will just tell you the answer."

Perhaps this may be put down to youthful ebullience, but supposing it became true?

4. The emerging Information Society – conflicts and paradoxes

This section is a kaleidoscope of bits and pieces culled from various sources and from the Web, an exercise in surfing with no pretensions to be academically correct or presenting a full and balanced account. Nevertheless, the websites discovered have been evaluated for their likely authenticity and, as far as possible, data has been checked by comparison with other sites.

4.1. Commercialization

When Tim Berners-Lee, credited with being the "father" of the World Wide Web, was developing his ideas he was working with CERN in Geneva and his initial interest was in making it easier to send large quantities of data over the Internet. Having written some effective protocols for data transfer he realised that the potential was there to broaden the scope of its use and potential user population. Like many such inventions, these ideas were born in a community dedicated to scientific research, and the use of the Web for commercial purposes had not been considered, but probably not unforeseen. At the end of 1993, less than 5% of sites were in the .com Domain, but by as soon as 1995 half of all sites had .com addresses and by half way through the following year this share had risen to 70%.

The effect on sales from 'bricks and mortar' outlets has been dramatic and, in some cases catastrophic. One of the most extreme examples is provided by the media giant Amazon which reached annual sales of $8 billion by the end of 2010, while sales through the retail chains of Barnes & Noble, and Borders went into decline in 2007. Amazon's sales continue to grow, while those of Barnes & Noble, and Borders (Rosenthal, 2012) continue to decline as do many well-established bookshops. The knock-on effect is also hurting publishers and authors as the market concentrates on titles that are likely to sell quickly. The advent of the electronic reader Kindle may further affect book sales.

A side effect of the above is that retailers are forced to establish attractive websites for those potential buyers who research before they buy, even from 'bricks and mortar' outlets; and this, in turn, leads to the practice of 'search engine optimization' whereby website owners pay consultants to ensure, through various nefarious devices such as keyword loading, that their website appears on the first page of Google hits. Google is, of course, a major winner of advertising revenue, and advertising is a major part of its profits. In Quarter 2 of this year, Google took $12.2 billion and this must affect the revenue-earning capacities of newspapers and magazines already hit by online competition to their main content, forcing them to set up their own websites.

Clever as many website designers are, they are not immune to ridiculous errors when it comes to handling text analysis. Crystal (2010) relates two incidences from TV where, in the first, a news flash reporting a street stabbing in Chicago was immediately accompanied by ads saying "Buy your knives here"; and a second example, even more hurtful and occurring in Germany, accompanying a piece about a tour of Auschwitz was an ad from a German power company advertising cheap gas.

4.2. Open Access Publishing

Not unconnected to the previous section is the knotty problem of Open Access Publishing. Instinctively, one feels that it must be a good thing, of great benefit to the research community making it easier for them both to publish and to more easily locate material of relevance to their research. It is also argued that it would make life easier for librarians, and profit the public at large in that research would be made more 'efficient' and that results and their consequences would filter more quickly into the public domain. The problem is that publishers, notably the giants Elsevier, Macmillan and Wiley, who claim that they provide an excellent service of quality control and efficient delivery, fear that revenues accrued from the annual publication by all publishers of some 1.5 million articles will be dramatically reduced if uncontrolled open access is allowed. One academic has answered in a letter to an English newspaper that "Scholarly publishing is the only industry that gets its raw materials free of charge and then sells them (highly priced) back to the institutions that provide them. The industry receives free services from academics acting as members of editorial boards, and as referees, the cost of which is paid by universities to support the commercial publisher" (Wilson, 2012). Most recently, there has been a new surge of discontent from academics, with 12,000 of them boycotting Elsevier; and more specifically expressing their wish to be able to use text and data mining techniques on huge databases of published articles (Jha, 2012). Such search and analysis is not so much concerned with the textual content of articles as with the desire, for example, to identify references to genetic sequences, or chemical substructures. In most cases these techniques are forbidden, but the publishers have promised to provide such access for specific projects. However, the procedure for gaining admission, particularly where several publishers are involved has proved to be cumbersome and expensive. There is now high level activity with proposals for the way forward: UNESCO has issued a set of policy guidelines whose title suggests that it is in favour of Open Access (Swan, 2012), and the UK government has announced its intention to accept and legislate for, the recommendations put forward in the Finch Report (Finch Group, 2012), named after its Chairperson Dame Janet Finch, and commissioned by the government. Though the report has been hailed as a measured study looking at all the pros and cons, not everybody is happy with its recommendations and the government's intentions to adopt them. Under the scheme, research papers emanating from government-funded projects will be made freely available online to anybody, anywhere in the world. The main objections from the universities, who currently pay some £200 million a year in journal subscriptions are now faced with taking a possible cost of £50 million out of their existing science budget to finance the transition, leading, it is feared, to less research and fewer published papers. In addition there are the proposed APCs (Article Processing Charges) to cover peer reviews and editing to be levied on authors (personally or through their universities) which it is estimated will be around £2,000 per article. Finally, there are some fears that the UK is "going it alone" (though there are significant Open Access sites in certain sectors in the US), the argument being that UK research publications represent some 6% of the world's total output, leaving the UK to pay for much of foreign research.

4.3. Power to the people and of the people

Though still open to debate as to details, there seems little doubt that mobile computing and widespread connectivity have contributed greatly to the comparative success of social movements such as "Occupy Wall Street" in America and the Indignados in Spain. Much has also been written about the use of social media throughout the "Arab Spring" acknowledging that the perception of it has changed, demonstrating to the world its power. Wikipedia has this to say about social media and the Arab Spring (Wikipedia contributors, 2012): "Such information allowed the world to stay updated with the protests and facilitated organizing protests. Nine out of ten Egyptians and Tunisians responded to a poll that they used Facebook to organize protests and spread awareness. Furthermore, 28% of Egyptians and 29% of Tunisians from the same poll said that blocking Facebook greatly hindered and/or disrupted communication."

This power can be harnessed for the creation of knowledge by the process known as 'crowdsourcing'. The classic example of this was described by the British scientist Francis Galton who, when visiting a country fair in 1906, noticed that in a contest involving 800 people asked to guess the weight of an ox, the mean of the guesses at 1197 pounds was closer than any of the individual guesses to the actual weight of 1198 pounds. More modern instances have included the story of the Canadian Goldcorp Company which was struggling financially, but believed that there was still gold to be mined from its land. It then put all its geological data online, asking for help on where the gold was located and offering $500,000 in prize money to be shared by those submitting accurate suggestions. Submissions arrived from all over the world, even including the use of 3D computer modelling techniques. Consequently, $3bn worth of gold was found on the property. Often it is the combined effort focussed on analysis of detail beyond the capability of individuals or even small teams. A striking example is the discovery of "Green pea galaxies" by what are known as "Citizen scientists" working together on a shared online forum. Focus and dedication seem to be the active ingredients of effective crowdsourcing, but mistakes can occur. A story is told of that excellent and successful crowdsourcing product Wikipedia by an author who discovered that the entry about him stated that he was dead. He corrected this through the online editing process, only to find that he had again been declared dead the following week .

A less optimistic aspect of the "wisdom of the crowd" has been put forward by Brynjolfsson and Van Alstyne (2005) following research challenging the assumption that Internet technology has an integrating effect; that " a global village is the inexorable result of increased connectivity". The authors say: "Because there are limits to how much information we can process and how many people we can communicate with (we have "bounded rationality", to use the academic jargon), we naturally have a strong desire to use filters to screen the ideas we're exposed to and the people we associate with. As the filters become more finely tuned, we can focus our attention – and structure our communities – with ever growing precision. Schelling's work shows that this process naturally breeds homogeneity in the real world, and our model confirms that the effects could be even more extreme in the virtual world." If this is true it would explain the entrenched polarity to be found in much of Western politics, particularly in the US.

4.4. What happened to time?

Communications technology, connectivity and other socio-economic factors are putting growing pressure on those in the workplace. Allen (2012) reports that "better overall productivity in an organization may not translate into increased productivity for an individual worker", and goes on to say that "...our new productivity tools are undermining our ability to get work done. They are causing us to become paralyzed by the dizzying number of options that they spawn". Comments collected by Allen included:

> I'm overwhelmed, and with all the changes going on here, it's getting worse. There aren't enough hours in the day to do my job.

> I have too many e-mails, and, given day-to-day urgencies, the backlog keeps growing.

This poses the question as to whether the Internet is changing the way we think, a question that was posed on Edge, the online forum of world renowned experts (Brockman, 2010). Some argued in the negative, as neuroscientist Joshua Greene of Harvard

> The Internet hasn't changed the way we think… It has provided us with unprecedented access to information, but it hasn't changed what [our brains] do with it.

or Cognitive psychologist Steven Pinker of Harvard:

> Electronic media aren't going to revamp the brain's mechanisms of information processing […] Texters, surfers, and twitterers have not trained their brains to process multiple streams of novel information in parallel.

But others disagreed (Communications scholar Howard Rheingold):

> The Internet fosters "shallowness, credulity, distraction," with the result that our minds struggle "to discipline and deploy attention in an always-on milieu".

The Internet —Evgeny Morozov, an expert on the Internet and politics— is also causing the

> disappearance of retrospection and reminiscence [...] Our lives are increasingly lived in the present, completely detached even from the most recent of the pasts […] Our ability to look back and engage with the past is one unfortunate victim.

Jenkins (2012)] speaks of "the death of conversation", as more and more people are equipped with iPhones and iPads and wear headphones as "conversational avoidance devices". He concludes that : "There is no time for the thesis, antithesis, synthesis of Socratic dialogue, the skeleton of true conversation". His view has recently been reinforced by the news that in the UK users are now more likely to text or email than to phone.

These rather bleak thoughts were voiced some sixteen years ago by Birkerts (Birkerts, 1996), under the title of a frail plea of an honest man confronted by a digital tsunami. He said

> [...] we are wiring ourselves into a gigantic hive. In our technological obsession we may be forgetting that circuited interconnectednes and individualism are, at a primary level, inimical notions, warring terms. Being "on line" and having the subjective experience of depth of existential coherence, are mutually exclusive situations [...] Depth, meaning, and the narrative structuring of subjectivity flourish only in that order of time Henri Bergson called "duration". Duration is deep time, time experienced within the awareness of time passing [...] We have destroyed that duration. We have created invisible elsewheres that are as immediate as our actual surroundings. We have fractured the flow of time, layered it into competing simultaneities. We learn to do five things at once or pay the price. Immersed in an environment of invisible signals and operations, we find it as unthinkable to walk five miles to visit a friend as it was once unthinkable to speak across that distance through a wire [...] We are giving up on wisdom, the struggle for which has for millennia been central to the very idea of culture, and that we are pledging instead to a faith in the web.

And yet...in the last sixteen years man has continued to make extraordinary progress in science and technology: in genomics and stem cell research, in medicine, organ transplants and prosthetics, and in cosmology and particle physics – most notably with the recent discovery of the Higgs boson.

The Internet may not be changing the way we think, but it is certainly changing the way we behave.

5. Conclusions?

Librarians and information scientists are affected as much as everyone by the information revolution, both as individual citizens and as information professionals, and must consider such issues as have been presented above, and a whole lot more. In order to understand the future possible roles of these two professional groups it may be helpful to take a brief look at some history and definitions. Libraries and librarianship are concepts that are still easily understood, even though their natures, and to some extent their roles, have changed. There were libraries of clay tablets in ancient Mesopotamia, catalogued and available for loan and Ptolemy's Library of Alexandria was a landmark in library history, whose size and ambitions are reflected today in national libraries such as the Library of Congress and the British Library. On the other hand, at least in he UK, the great industrial libraries of the immediate post-war years have all but disappeared; government and university libraries are struggling; and the public libraries, spreading their budgets across multimedia, computer facilities, foreign language collections for ethic minorities and extraneous events have become community centres – but still libraries. In short, it would seem likely that librarians will continue to be curators of information resources, both physical and digital, while providing a range of associated services.

The future of information scientists is far less clear, and it is necessary to look at the terms information scientist and information science more closely. Consulting the *Oxford English Dictionary* it would appear that the term 'information scientist' pre-dates the term 'information science' by a couple of years, both being coined by Jason Farradane, a co-founder of the UK Institute of Information Scientists (IIS) and of the first school of Information Science at City University, London. The definition of the former is "a person trained in providing an information service, especially in respect of scientific or technical information". In fact, membership of the IIS required a person to have a degree in science or engineering, a second language, and five year's experience in information science – this last word being brought in to encompass the range of topics that would form the syllabus for would-be information scientists. Others, notably B.C.Brookes argued that there was such a legitimate science of information, it being one of the social sciences.

As for the practice of information science, it became obvious that there were many academically qualified people in a wide range of subjects providing information services through a wide variety of libraries and, indeed, other formal channels. When the IIS collapsed it was merged with the Library Association to become the Chartered Institute of Librarians and Information Professionals (CILIP); this second category not being clearly defined and seeming to suggest (probably unwittingly) that librarians were not information professionals. It is argued here that this lack of a definition or a meaningful summary of its scope is what creates uncertainty concerning the potential and developing roles of traditional information scientists. It is instructive to look at the ways in which in the UK, what were known as 'Library and Information Schools' in the universities (some of which attached themselves to Computing Faculties or Business Schools) have changed their names:

- Aberystwyth: Department of Information Studies
- Brighton: Department of Information Studies
- City, London: School of Informatics
- Loughborough: Department of Information Science
- Sheffield: Information School
- UCL: Department of Information Studies,

none of which have maintained the word 'Library'. The problem here is that a number of views and activities are hiding under this word 'information' at a time when the word has become so widely used as to become almost meaningless. Marijuan et al. (2012) have stated that: "Biology has really become an information science". Going even further. Quantum physicist Vlatko Vedral (2010) is reported as saying that "units of information – not particles – are the building blocks of humanity and everything that surrounds us. Information is what came before everything else" Philosophically, both of these statements are acceptable, but pragmatics requires us to be more precise in defining the work of those who profess to be full-time information professionals, as well as others that such professionals might be recognized by them as being fellow information professionals. This is partly a matter of whether they belong to a professional association, and to which one, it being clear that CILIP represents only a fraction of information professionals.

There has been much talk of the word 'disintermediation', whereby librarians and information professionals no longer have personal contact with end users. Not only is this overstated, as there are still many instances where this is not true (the "embedded librarian" is a concept worth examination), but intermediation can, and does, occur at other points in the information chain. Traditionally, we are talking about 'information services' as in the earlier definition of information science, but again, the concept of service can be widened to include the 'servicing' of end users at any point in the information chain. I would suggest that there are at least six separate information activities, closely related, and that the workers in each should have a good understanding of the work of the others In certain instances an individual may take on multiple roles. These roles are:

- *Information Architecture:* The design of information systems so that they fit appropriately into the wider enterprise architectures.
- *Information Management:* The management of information systems from the enterprise level to that of specific sub-systems.
- *Knowledge Organization:* The compilation of semantic and syntactic structures to support all sorts of knowledge-based activities, not just those with a service orientation. The focus of this activity is metadata and terminology management, but with a firm understanding of their application and use.
- *Knowledge Management:* The creation of systems to support the transfer of tacit information.
- *Librarianship:* The curation of information resources and making them available.
- *Publishing:* The creation of resources in physical or digital forms.

To these could be added two areas of expertise with, perhaps a stronger emphasis on computing:

- *Informatics:* A particular fusion of information processing and computing, most clearly exemplified by Chemoinformatics which combines the processing of textual and numerical chemical information with chemical structures; and, to an increasing extent, Health informatics which seeks, for example, to relate medical information to patients' records.
- *Knowledge Engineering:* The integration of knowledge with computer systems to support problem solving.

And that leaves Information Science as a field of study in its own right, but open to all with an interest in the phenomenon of information in all its guises. Information science should include Informetrics in a wide sense to include not only bibliometrics, but evaluation of information systems. Another promising avenue of approach is provided by Social informatics - "the study of information and communication tools in cultural and institutional contexts".

The former 'information scientists' can and should contribute to all these activities, working with others, particularly knowledge engineers and computer scientists There is an enormous amount of information-centric work to be done as the 'information revolution' permeates our societies; in academia and the public sector, in commercial enterprises, in web delivery systems, in linked data systems and in the wider development of the Semantic Web.

This leaves unanswered what we may mean by the plural 'information sciences', but this may be a topic of consideration for information science!

6. References

Allen, David (2012). When technology intrudes. // The New York Times. (March 25, 2012).

Birkerts, Sven (1996). The electronic hive: refuse it. // Kling, Rob. Computerization and controversy. 2nd Ed. San Diego: Academic Press. 1996.

Brockman, John (ed.) (2010). The Edge Annual Question 2010: How is the internet changing the way you think? // Edge World Question Center. Edge Foundation, 2010. edge.org/q2010/q10_index.html (last accessed 26 July 2012).

Brynjolfsson, Eric and Marshall Van Alstyne (2005). Global village or Cyber-Balkans. // Management Science. 51 (June 2005) 851-868.

Carr, Nicholas (2008). The big switch: Rewiring the world from Edison to Google. New York: W. W. Norton & Company Inc. 2008.

Crystal, David (2010). Semantic targeting: past, present and future. // Aslib Proceedings. 62:4/5, 355-365.

Finch Group, The (2012). Finch Report: Report of the Working Group on Expanding Access to Published Research Findings. // Research Information Network. (20 August 2012). www.researchinfonet.org/publish/finch (25 July 2012).

Freshwater, R. (2010). UK telephone history: A historical web site about UK Customer Telephone Apparatus & Systems. Author, 1998-2012. // The telephone file. Last revised: December 20, 2010. http://www.britishtelephones.com/histuk.htm (15 July 2012)

Gaur, Albertine (1992). A history of writing. London: The British Library. 1992.

Gleick, James (2011). How Google Dominates Us. // The New York review of books. (august 18, 2011. http://www.nybooks.com/articles/archives/2011/aug/18/how-google-dominates-us/? pagination=false (23July 2012).

Hopkins, Nick. Hackers have breached top secret MoD systems, cyber-security chief admits. // The Guardian, 3 May 2012. http://www.guardian.co.uk/technology/2012/may/03/hackers-breached-secret-mod-systems

Jenkins, Simon (2012). Now everyone is connected, is this the death of conversation? // Guardian. (26 April 2012).

Jha, Alok (2012). It's a useful research tool, so why forbid it? // Guardian. (24 May, 2012).

Krotoski, Aleks (2010). Look at the numbers first: Interview with Vlatko Vedral. // Observer. (7 March 2010).

Kunder, Maurice de (2012). The size of the World Wide Web (The Internet). // WorldWideWebSize.com http://www.worldwidewebsize.com/ (20 July 2012).

Marijuan, Pedro C., et al. (2012). Scientomics: an emergent perspective in knowledge organization. // Knowledge Organization. 39:3 (2012) 153-164.

Miniwatts Marketing Group (2012). Internet usage statistics: the Internet big picture. // Internet World Stats. http://www.internetworldstats.com/stats.htm (20 July 2012).

OEDb (2012). The Ultimate Guide to the Invisible Web. http://oedb.org/library/college-basics/invisibleweb (23 May 2012).

Pingdom (2011). Internet 2010 in numbers. // Royal Pingdom. Pingdom AB, 2011. http://royal.pingdom.com/2011/01/12/internet-2010-in-numbers (20 July 2012).

Rosenthal, Morris (2012). Book Sales Statistics: Amazon, Barnes&Noble and Book Store Sales Numbers Annual Update. Jerusalem: Author. // Foner Books www.fonerbooks.com/booksale.htm (23 July 2012)

Stoddard, Samuel (comp.) (s. d.). Bad predictions. // Rinworks. Things people said. New Hampshire: Author, 1996-2011. http://www.rinkworks.com/said/predictions.shtml (15 July 2012)

Swan, Alma. Accessibility, sustainability, excellence: how to expand access to research publications. // Policy Guidelines for the development and promotion of Open Access. Paris: UNESCO, 2012.

Wikipedia contributors (2012a). Effect of Social Media on the Arab Spring. Wikimedia foundation. 2012. http://en.wikipedia.org/wiki/Arab_Spring#Effect_of_Social_Media_on_the_Arab_Spring (26 July 2012).

Wikipedia contributors (2012b). Mobile phone. Wikimedia Foundation, 2012. http://en.wikipedia.org/wiki/Mobile_phone (20 July 2012).

Wilson, T. D. Open access plan is no academic spring. // Guardian. Letters. (18 July 2012). http://www.guardian.co.uk/science/2012/jul/18/open-access-plan-no-academic-spring

Worldometers (2012). Computers sold this year worldwide. // Woldometers info. Dadax. http://www.worldometers.info/computers/ (23 May 2012).

Enviado: 2012-07-28. Segunda versión: 2012-08-01.
Aceptado: 2012-09-20.