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Perspective Review of the Evolution and Application of Information Science

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Abstract The purpose of this paper is to critically review literature pertaining to the evolution and application of Information Science so as to understand varied perspectives and attempt to address the following questions: what influenced the origin of Information Science; what was predicted to happen in the modern times; And how has the evolution and application of Information Science has impacted on the information services sector in the 21st century. Using the desk review approach to understand the subject matter based on published online literature from 1990 onwards. The paper examined the evolution and application of Information Science by reflecting on the evolution and application of Information Science from different schools of thoughts as reviewed from literature. We discussed the evolution based on the historical, documentation movement, institutional, sociological, technological, interdisciplinary, and philosophical perspectives. The paper concludes with a critique on the application of Information Science. This study is juxtaposed with Rayward, (1996) conclusions that suggested "the evolution of Information Science is an historical interdisciplinary and those interested in it need to draw on a range of related historical studies such as the history of science and technology, the history of printing and publishing, and the history of information institutions such as libraries, archives and museums". We concluded that the trend brought about by the Internet through Information Technology has enabled Information Science field to simplify the processes of acquisition, processing, storage, retrieval, and dissemination of information to be used by various stakeholders. The Industrial Revolutions have facilitated the emergence of more robust trends in the application of Information Science within the professional practice and academic spheres. As such, Information Communication Technology (ICT) has become part of Information Science and we re-affirm that they complement each other.

Keywords Information Science, Information, Evolution, Library Science, Trends

1. Introduction and Background

Information Science is undisputedly believed to have transitioned from librarianship as a result of information explosion. The world needed scientific and technological solutions to process, manage, store and transmit vast amounts of data/information. Boonstra et al., (2004) defined Information Science as the discipline that focuses on the processes of gathering, manipulating, storing, retrieving, classifying and transferring information. It can be treated as a broader concept with the unifying attributes for related concepts and methods from various disciplines such as library science, computer science and communication science.

Information Science generally is believed to possess certain characteristics found to be the formation blocks for the thematic areas that include interdisciplinary nature; very close association to Information Communication Technologies; and for playing a critical role in the development and institutionalization of the Information Society (Saracevic, 2000). Qualifying that the themes are overlap with various contemporary fields and can be viewed as problem areas with which Information Science was established to work with. Saracevic, (2000), portrays a conceptually justified view because information technology is a subset of Information Sciences. Information technology aids Information Sciences in delivery services like information processing, management and dissemination.

The evolution of Information Science has been documented through various accounts of several researchers. There seems to be a shared perception that the evolution of Information took place around the Second World War era to solve the problem of information explosion hence adopting the enhanced use of Information Technology and scientific inquiry in professional practices. Specifically established to deal with the constraints of acquiring, storing, managing and communicating information because it facilitates interaction between people, organizations, and information systems (Mcgonigle and Mastrian, 2011). A literature review

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approach was adopted to critically make a holistic examination, discuss the emerging issues and make pronounced conclusions.

2. The Aim

A lot of changes have taken place since the evolution of information science given the advancements in Technology and transformation brought about by the industrial revolutions. The influx of trends in the information services sector necessitates a critical review to establish the milestone achieved and critically reflect on how Information Science evolved classified into the historical, documentation movement, institutional, sociological, technological, interdisciplinary, and philosophical perspective. In view of the rationalisation predicament, we attempt to address the following questions: what influenced the origin of Information Science; what was predicted to happen in the modern times; and how has the evolution of Information Science impacted the information services sector in the 21st century. We adopt the literature review approach to critically make a holistic examination, discuss the emerging issues and make pronounced conclusions.

3. Methodology

This paper adopts the desk review approach to identify published literature related to the evolution of in Information Science. We used My Library on Fingertips (MyLOFT) as access platform for most of the open access literature and subscribed content by Consortium of Uganda University Libraries (CUUL). The search query was formulated and executed using LIBHUB a library online discovery tool embedded within MyLOFT alongside EbscoHost Discovery and Google Scholar. Once the results were displayed, filters were applied to exclude articles older than 1990. Over one hundred articles were evaluated for relevance and we found 21 articles with critical aspects to be considered in our review and discussion. It should be noted that the authors' attempt to be comprehensive could have been limited by subscription and authentication restrictions instituted by various publishers and e-resources platforms.

After reading the downloaded articles and constituting author discussion meetings held on zoom video link, we then conducted a collective synthesis to identify predominant ideas and classified them into thematic areas. Working as a team meant distributing responsibilities and harmonizing positions based on assigned tasks. When we embarked on the writeup, the following categories characterized the review of evolution of Information Science: the historical, documentation movement, institutional, sociological, technological, interdisciplinary, and philosophical perspectives. We examined varied perspectives by explaining, critiquing, supporting and supplementing arguments put across by several researchers. At the end summaries and conclusions were drawn based on our perceived understanding of the subject matter. We did acknowledge the authors of consulted literature through citation and attempted to minimize bias by reminding ourselves about our ethical obligation and through diversity of contributing authors to this paper.

4. Review

The nature of Information Science

Whereas Information Science is reported to have progressed systematically, it is important to understand its composition. Scholars have alluded to the fact that Information Science can be treated as an academic discipline as well as an information services professional practice (Bowden 2007). This discipline is established in the scope of information services provision, and stretches beyond the processing and management of documented knowledge to the dissemination and utilisation of useful and complete information in a timely and efficient manner (Bates, 1999). There is therefore no doubt that Information Science employs Information Communications Technology in the delivery on Information Services as a multidisciplinary field focussing on the study of various sources of information and how that information is processed and conveyed for human consumption.

Information science is assessed as a discipline that finds its way into both the social sciences and computing as an interdisciplinary scientific subject - structured within the Higher Education academic setup. Generally, most Higher Education Institutions of Learning in Europe consider the teaching of Information Science in the i-Schools while others place them in the communication, computing, informatics, business schools, social sciences and human sciences, education and the interdisciplinary sciences among other options. This expands the concept of Information Science as a postmodern science, a meta-science, an inter-science, a superior science, an interface science among others. (Bawden and Robinson, 2012).

Although it was generally believed over the years that Information Science is a social science (Roberts, 1976, Cronin, 2008), it has been established through the process of domain analysis that Information Science is a subject focused with the science of processing, managing and conveying information in a complete and usable state. It is treated based on social theory as a social science and fundamental science based on the information society theory.

Historical Perspective

Information Science evolved during the Second World War and blossomed in the aftermath together with several other fields including computer science. This period was characterized with the rapid pace of scientific and technological growth leading to the development of the scientific and technical revolution around the 20th century.

As observed by various scholars, this revolution manifested into the information explosion phenomenon that was considered unrelenting, exponential influx of scientific and technical publications on information science and related disciplines (Saracevic, 2017).

It is further observed that Information Science is still an infant discipline and that there is no need to deliberate whatsoever its history towards the 1950s. However, it has been highly contested because there exists background documentation pertaining the evolution of Information Science beyond the 1950s hence there is acoustic value in understanding the past by digging deep into the archives about any given discipline so as to inform future innovations within the discipline. Moreover, histories help in giving perspectives on current problems and solutions. Although contexts and technologies may change, many information issues remain constant over time, and a historical perspective can be of empirical as well as academic value.

Information Science is empirically presented as a modern generation of communication or behavioral disciplines that gained attention almost during the escalation of the Second World War. At the time when information and research was weaponized as a tool for laying strategy and gaining control of the knowledge base, Information Science became known as a basic area of inquiry that reached higher levels of conceptualization (Harmon, 1971).

On a separate account, Chua and Yang, (2008) argued that Information Science can historically be referred back to 1000 BC, but was only recognized in the academic circles after the second world war. Based on the ultimate design and focus on the representation, storage, transmission, and use of information and messages, this concept has revolutionized the library studies into areas as diverse as the sciences, humanities, law and medicine. The varied perspectives are based on this phenomenon propelled by the necessity to define the contextual, institutional, methodological, technological and theoretical aspects of information (Buckland & Liu, 1995). We do agree with Chua and Yang that Information Science has grown beyond the confines of library studies, this has been seen in the application of Information Science in various disciplines in accessing current knowledge and organization of information within these disciplines. In our view Information Science is applied in the functioning of the various disciplines of sciences, humanities, law and medicine. This is partly because all the disciplines have knowledge management, information systems and records management embedded in them.

Fundamentally Information Science appears to have gained significance as a discipline in 1962, with several scholars attributing to fundamental sciences. It appeared to unilaterally shape the development and ratification of fundamental branches that emerged in the late 1960's. Giving rise to documentation and information retrieval as communication disciplines associated with Information Science. The 1970s saw scholars define Information Science in association with modern generation of communication and behavioral sciences. As predicted in the early 1970s Information Science achieved completeness as a disciplinary system and attained a relative state of maturity in the 1990s as expected (Harmon, 1971).

This can be attributed to the 3rd Industrial Revolution that brought about significant transformations in the Information Science discipline. With the advent of the 4th industrial revolution, it is more likely to qualify the prediction that specialization within the Information Science discipline would become more intense. The programmed development of Information Science was to embrace more the science of research which has possibly existed before as a concealed component of Information Science (Harmon, 1971). Further speculation into the two decades after 1990's was that of new fusions and fissions, with attendant name changes (Harmon, 1971) as witnessed today with the role changes of Information Science professionals as information gate keepers, systems librarians, e-resources librarians, learning and research commons managers, to mention but a few.

One of the main contributors of the evolution of information research Saracevic, (1999) interrogated the turn of events and reflected that in more than a half a century ago Vannevar Bush a renowned scholar published an article in 1945 where he concisely defined a critical problem of the increasing growth of knowledge termed as data explosion, this problem was sweeping across several minds of scholars for a long time. Bush suggested an Information Science solution regarded to be the most appropriate "technological fix". The problem of "data explosion," was attached with the urgent need to provide availability of and accessibility to relevant information in an efficient and timely manner. It is widely believed that Bush's solution propelled the development of digital libraries which were using the emerging information technologies to propagate the Information Science concept in addressing the data explosion problem.

Awing to the intervening accounts on evolution of Information Science, Hjørland, (2014) reflects that the term 'Information Science' dates back to 1955 with remarkable prominence taking place after the development of Claude Shannon's 'information theory' in 1948. As a new trend at the time, researchers ventured into the identification of problems in fields of library science and documentation hence the modeling of the Information Science concept, with a curriculum designed as 'library and Information Science' (LIS). Although the relevance of Shannon's information theory as the theoretical foundation of the field was challenged, the story had served its purpose. Hjørland, (2014) argues that some of the strongest "paradigms" in the field of Information Science is a tradition derived from the Cranfield experiments in the 1960s and the bibliometric research following the publication of Science Citation Index from 1963 onward. Adding that one of the competing theoretical frameworks, 'the cognitive view' became influential from the 1970s.

However other schools of thought have agreed to Shannon and Weaver theory as being the foundation for science given the fact that their theory states that information is transmitted

from the source through a channel in bits (0's and 1's) and moves through a receiver to the destination (recipient). This shows the process of dissemination of information from the originator to the user which is a valid component of Information Science. Our view is that the Shannon and Weaver theory has continued to influence reflections to the evolution of Information Science and is bout withstand the test of time.

In a nutshell Xue-Shan Yan, (2011) articulated that the evolution of Information Science took effect around the late1950s to the early 21st century and the following stages are attributed to its development. From 1948 to 1959 this is known as the embryonic period of Information Science, from 1959 to the present is known as the coexistence period of three classical Information Sciences, from 1974 to the present is known as the prosperity period of the sector informatics, and from 1994 to the present is known as the blueprint period of unified information study.

Documentation movement perspective

Although it is clear to many scholars that Dr. Ranganathan is the father of library science after he established the Five laws of Library Science, the building blocks continued as established in by many historians on the evolution of Information Science from the documentation movement angle. Day, (2001), observed that the discipline of documentation science, which marks the earliest theoretical foundations of modern Information Science, emerged in the late portion of the 19th century in Europe together with several more scientific indexes whose purpose was to organize scholarly literature. A movement founded by Paul Otlet (1868-1944) and Henri Lafontaine (1854-1943) who have enjoyed scholarly mentions for decades as the fathers of Information Science because of the International Institute of Bibliography (IIB) that they established in 1895.

After World War two, a second generation documentalists from Europe emerged, remarkably among them was Suzanne Briet. However, "Information Science" as a term was not widely used in academic circles until sometime in the final portion of the 20th century. Documentalists highlighted the practical incorporation of technology and technique toward specific social goals. We therefore agree that documentalists played a big role in the development of Information Science because documentation has continued to play a big role in the various disciplines of Information Science today. The technology they emphasized is now more utilized in the field of Information Science as it is being applied in the collection, organization, retrieval and dissemination of information.

From a fundamental point of view Day, (2001), asserts that Information Science is an organized system of techniques and technologies whereas documentation was treated as a stakeholder in the historical development of global organization in the postindustrial era. Adding that Otlet and Lafontaine not only predicted practical innovations but also expected a worldwide dream for information and information technologies projected directly to the post war dreams of the Information Society. There is no doubt that the world is a global village interconnected using a conglomerate network of Systems, Webpages and Internet of Things based on information technology that has become part of Information Science and now complement each other.

The structured document collection development system led to the development of indexes for authors, titles and subjects which are being applied in the organization of knowledge and are very crucial attributes in the field of Information Sciences. By 1937 documentation had formally been established, as evidenced by the founding of the American Documentation Institute (ADI) which was later called the American Society for Information Science and Technology. (Robert V. Williams, 2012). From the analysis above the documentalist played a big role in the evolution of Information Sciences, they lead a foundation for the subject of the organization of knowledge which is one of the components of Information Science.

Institutional perspective

The institutionalization process of Information Science was planned and propagated throughout the 18th century. During the 19th century, several developments occurred among which was the institutionalization of Information Science along with many other social science disciplines. The scientific aspect is attributed to the history of science that was established in 1965. As such, the Royal Society of London launched the first publication of the first issues of Philosophical Transactions which was regarded the first scientific journal to feature Information Sciences research. (The Royal Society booklet, 2015). It can be observed that this was the commissioning of Information Science discipline into the scientific research arena.

By implication, the Library Company of Philadelphia that was established in 1731 by Benjamin Franklin became the first library to be registered a public information institution owned by a group of public citizens. This library quickly transitioned from the concentration of books to the processing and management of scientific information and data experiment gaining momentum to host public exhibitions of varied information resources and scientific experiments. It also became inevitable for Benjamin Franklin to invest more in the development of similar institutions in Massachusetts town with a freely accessible collection of books courtesy of the town vote and founding of the first Public Library (MA Bicentennial Commemorative Edition, 1990). The institutionalization enabled the publication of a journal and establishment of a library which both contribute to the field of Information Science. Today a wide array of institutional libraries does exist thanks to the Massachusetts town initiative.

Sociological Perspective

Sociologically Information Science is viewed as a field devoted to scientific inquiry and professional practice with ultimate goal of addressing the problems of effective communication of knowledge and information resource curation and management among humans in the social and intuitional contexts of information needs (Saracevic, 1999).

Information Science evolved to address problems of information seeking, retrieval and dissemination in a socially networked environment, taking as much advantage as possible of the modern Information Communications Technology (ICT). However, Saracevic did not cater for the process of collection and processing of information which are components of Information Science. Information Science should therefore involve the process of information gathering, collection, processing, analysis, storage and finally dissemination to their target audiences.

Reflecting the account of the historical perspective Harmon, (1971) theorized that the potential long-range role for Information Science involves active participation in forming a complete super system of knowledge which would unify the arts, sciences and professions. Adding that Information Science could strive to overcome the limitations of human short- term memory and thereby increase the scope of human comprehension.

The social media concept emerged with the 3rd Industrial Revolution and is taking center stage with Information Science taking strategic advantage. The concept of Information Science is however, seen to be fragmenting, yet several schools of thoughts observe that the concept should now be understood from the sociological context in relationship to theories of knowledge and understood from a social and cultural perspective, which helps to re-establish connections with ideas such as social epistemology which may have remained contained in in the field much of the time (Hjørland, 2014). Today Information Science cuts across the fields of science, arts and humanities therefore justifying the predictions made by Harmon in 1971 and also applies knowledge as one of the its fields of study.

Technological Perspectives

Information Technologies (ITs) are used in the building blocks for the establishment of the Information Science (IS) concept to help address the problem of data explosion and ensure data integrity and efficient information processing, management and dissemination (Saracevic, 1999). Information Technologies that complement Information Science are of fundamental value ensuring safeguards, such as routine file backup, error detection during transmissions, and development of user interfaces that help people enter the data correctly, store and retrieve accurate information in an efficient and timely manner. Information Science grants fundamental characteristics to information while Information Communications Technology (ICT) provides the platform and tools for offering effective service.

As a general rule, information managed by the help of technology should be valuable, meaningful and of good quality possessing the following attributes: availability, safety, timeliness, correctness, relevancy, comprehensiveness, flexibility, impartiality, usefulness, transparency, reliability and reproducibility. Acquisition, management, storage and communication of information by way of electronic means led to the evolution of Information Science to support active search, efficient retrieval and having it conveyed by the networked environment. Information Science introduces robust classification and cataloguing systems with effective search and retrieval strategies, ensuring that people receive information from computers and related means (Mcgonigle & Mastrian, 2011). Information Technology has enabled Information Science field simplify the processes of acquisition, processing, storage, retrieval, and dissemination of information. As such, Information Technology has become part of Information Science and we re-affirm that they complement each other.

Interdisciplinary perspective

Information Science revolutionizes the Library, Archives and Museum architecture to leverage technological advancement. It employs a wide array of Information Communications Technologies (ICTs) as an intervening concept in the production and use of knowledge through the construction and management of documentary systems while taking center stage in the deployment of classification, indexing, cataloguing and documentation information systems. Revelations by Ortega, (2009) suggest that the fundamental adaptation of librarianship, museology and archival science is based on the exploitation of the advancements in Information and Communications Technology which strengthened the interdisciplinary linkages of knowledge management concepts. The ultimate evolution of Information Science approach, whose operations prioritized relevant, varied, adequate and cumulative acquisition of information and knowledge resources that are robustly processed with vast storage allocation leveraging electronic form advantage in terms of representation, retrieval, storing, access and usage promotion.

Arguably, the concept of librarianship was limited and restrictive in the way information resources collection was developed, managed and transmitted including the perception of roles and responsibilities of the professionals in this field (Hjørland, 2018). The Information Science concept modifies the historic roles of the library, archives and museum professionals in reference to Jason Farradane (1906–1989) testament that featured in an article published in 1955 about the education of information scientists which was coined by Farradane (1953) to refer to documentalists. According to (Kline, 2004) the professional fields such as library science, science of bibliographies, scientific information and documentation can be conceptualized as the predecessors of Information Science. Information Science transitioned around the early 1960s when the fields of bibliography, documentation, and scientific information that had persisted during the first five decades of the twentieth century became obsolete as evidenced when the American Documentation Institute (founded in 1937) became known as the American Society for Information Science in 1968 and later the Association for Information Science and Technology.

More recently Mcgonigle & Mastrian, (2011) articulated that Information Science was an interdisciplinary,

people-oriented field that explores and enhances the interchange of information to transform society, communication science, computer science, cognitive science, library science, and the social sciences. They believed that society was subjected to the demand for information and knowledge. They believed that Information Science concentrates on systems and specific users fostering user-centered methods that improve effectiveness and efficiency in connecting people, information and technology. The perspective reflects on the relationship with various stakeholders in the evolution and operationalization of Information Science.

The latest definition of Information Science as provided by Web Dictionary of Cybernetics and Systems, (2021), stating that Information Science is an extensive, interdisciplinary science that integrates features from cognitive science, communication science, computer science, library science, and social sciences. This definition tends to re-affirm the projections outlined by Information Science historians such as Harmon, 1971. The escalation of technological advancement in the Information Communications Technology has led to improved innovations and sustainable recognition of the contributions of the Information Science sector to the economic development in society while the Information Science professionals have been acknowledged as key stake holders in the United Nation Sustainable Development Goals (UN SDGs) action.

Philosophical Perspective

From the epistemological debate researchers seem to be deliberating on the impact of computing more so the Internet that is believed to be the master piece that influenced the evolution and development of Information Science revolutionizing the ways in which information is acquired, managed, communicated and how knowledge is generated and used in the fields of humanities. (Boonstra et al., 2004). It's right to suggest that Philosophy contributed to the evolution of Information Science through the application of epistemology which involves the generation of knowledge. Knowledge is an important component of Information Science and continues to apply information technology.

Notwithstanding the fact that information is processed data that must be conveyed in a complete and usable manner Mcgonigle & Mastrian, (2011) reveal that Information Science approach is complex requiring application of the fundamental principles to itself, the people, the technology, and the diverse sciences that are contextually related. Awing to the fact that information access and usage is critical in utilization of the concept of Information Science, it is expected that the interface between the patrons and their structures should be robust and appealing allowing users to quickly address their information need. Although certain concerns have to be addressed in the process such as revelation, access, exchange, ownership security, privacy, disposal and dissemination.

In a recent reflection on how much research is established in the field of Information Science Garci, (2017) observed that research into Library and Information Science has exponentially grown over the last four decades in terms of volume, internationalization, degree of specialization, areas of application, and its interdisciplinary relations as data based in the scientific academic journals including but not limited to LISA, LISTA, ERIC and WOS. This is a good revelation and more Information Science research is likely to feature in many more publishing databases as witnessed today.

5. Summary and Conclusions

The evolution of Information Science happens to have been a blessing to the actors that facilitated the Second World War as more robust and efficient ways of securing, handling, managing and transforming information became available and although limited in context at the time. Furthermore, the Information Science concept has played a fundamental role in reshaping the trajectory of the industrial revolutions and facilitating significant improvements in the information society. In a summative account Xue-Shan Yan (2011), seems to agree with several scholars on mainly the historical and technological perspective summarising that the history of Information Science concept was initially proposed in 1959 by scholars in the computer science discipline but did not progress to achieve the intended purpose at the time. The progress was registered in 1960 when documentation became automated and documentation retrieval systems were established by the library scientists who replaced the traditional name of Library Science with Information Science.

Consequently, this gave rise to the concepts of "Computer and Information Science" and "Library and Information Science" to distinguish computer science from library science as Information Science related disciplines. We would like to agree with Xue on the phase library and Information Science, however with the advances in technology emerging within the field of Information Science, the phase should change to Computing and Information Science to accommodate the discipline of Information Technology (IT).

Information Science and Computing complement each other, we therefore want to suggest that the computing should be part of Information Science which is broader than Communication Technology. Important to highlight that the documentation movement evolved from librarianship paving way for the evolution of Information Science. Even though information science is relatively a young discipline, the questions to which it seeks answers are not new. Several scholars have given the account on how Information Science was developed and institutionalized in America, Europe and Asia which gradually radiated to the rest of the world.

While information science certainly shares with librarianship the social role of securing the effective use of human graphic record, more modern disciplines have

become increasingly more important to information science. The proliferation of Information Technology (IT), the convergence of Computing and Telecommunications and the rapid growth of the Information Sector of the global economy have contributed to the fact that Computer Science is closely related to Information Science. The merging of Information Science with these other disciplines has strengthened its theoretical foundations, allowing old problems to be examined in new ways.

Another major concern is that information science should be immersed into the bigger academic disciplines that are gradually interested in information communication, especially Computer Science and Information Systems. The future of Information Science as a discipline might be affected by changes which might introduce new knowledge. Its future shouldn't be thought about in terms of current trends and issues affecting the discipline. There is need to draw inspirations from hypothetical writings of the future scholars. It is certain that information science has a bright future, though its details cannot be known. Only general predictions of the future Information Science landscape can be made.

Conclusions

The Industrial Revolutions have facilitated the emergence of more robust trends in the application of Information Science within the professional practice and academic spheres. As such, Information Communication Technology (ICT) has become part of Information Science and we re-affirm that they complement each other. Our view is that the Shannon and Weaver theory has continued to influence reflections to the evolution of Information Science withstanding the test of time. Like many scholars agree, we re-affirm based on the available evidence in the literature that Information Science was established to deal with the process of collecting information, processing, storing and disseminating this information for use by different stakeholders.

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