Redefining information science: from "information science" to "knowledge science"

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Abstract

Purpose – This philosophical essay aims to explore the concept of information science.

Design/methodology/approach – The philosophical argumentation is composed of five phases. It is based on clarifying the meanings of its basic concept "data", "information" and "knowledge".

Findings – The study suggests that the name of the field "information science" should be changed to "knowledge science".

Originality/value – The paper offers reflections on the explored phenomena of information science.

Keywords Information science, Philosophy

Paper type Research paper

Overview

What is the essence of information science? What are the boundaries of its knowledge domain? The quest for identity is explicit in numerous studies and position papers (for example, Bates, 1999; Borko, 1968; Brookes, 1980; Debons *et al.*, 1988; Farradene, 1980; Hawkins, 2001; Hjorland, 1998; Hjørland and Albrechtsen, 1995; Neill, 1992; Saracevic, 1999; Vakkari, 1996; Vickery, 1997). It is reflected in overviews of the history and the foundations of the field (e.g. Buckland, 1999; Buckland and Liu, 1955; Heilprin, 1989; Ingwersen, 1995; Shera and Cleveland, 1985; Zunde and Gehl, 1979). This quest for identity is manifested in various studies that are aimed at clarifying the conception of information or establishing a theory of information for the field (e.g. Buckland, 1991, and the overviews of Boyce and Kraft, 1985; Cornelius, 2002, 2004, Floridi, 2002, 2004).

Apparently, there is not a uniform concept of "information science". The field seems to follow different approaches and traditions; for example, objective approaches vs cognitive approaches, the library tradition vs the documentation tradition vs the computation tradition, and so on. The concept has different meanings. Different meanings imply different knowledge domains. Different knowledge domains imply different fields. Nevertheless, all of them are represented by the same name, "information science". No wonder that even scholars and practitioners are subject to confusion.

Furthermore, even the name "information science" is problematic. If one takes the three related concepts "data", "information", and "knowledge" that are embodied in the concept "information science", one cannot ignore the difficulty. Generally, the three concepts are mutually related. Data is commonly conceived as the raw material for information, which is commonly conceived as the raw material for knowledge. Knowledge is the highest order construction. If this is the case and 'information science' deals with all three, then it should be called "knowledge science", rather than

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"information science". Note that "knowledge science" can explore knowledge and its building blocks, information and data, but "information science" cannot explore knowledge, since the latter is of a higher order.

Two possible arguments can help resolve this difficulty. First, one can refute that knowledge is of a higher order, and claim that in the context of information science "information" and "knowledge" are synonyms. However, since "knowledge" is a well-known term rooted in our culture, it seems more reasonable to substitute "information science" with "knowledge science". The second argument is even more challenging. It is based on the notion that information science is focused on the objective realm of information (i.e. as an object), while knowledge is a construct of the receiver's human mind. Accordingly, information systems create, transmit, store, and manipulate information, not knowledge. Still, followers of this position should either admit that the sub-fields (knowledge organization, knowledge management, and the like) are not part of information science, or rather change their names to "information organization", and "information management".

This philosophical essay explores the concept of information science. The philosophical argumentation is composed of five stages. First, I shall differentiate between two approaches to defining "knowledge", namely, subjective knowledge (i.e. knowledge as a thought) and objective knowledge (i.e. knowledge as an object or a thing). Note that "subjective knowledge" is equivalent here to the knowledge of the subject or the individual knower, and "objective knowledge" is equivalent here to knowledge as an object or a thing. Subjective knowledge exists in the individual's internal world, while objective knowledge exists in the individual's external world. In this context, they are not related to truthfulness and arbitrariness, which are usually attached to the concepts of "objective knowledge" and "subjective knowledge". The distinction between subjective knowledge and objective knowledge is essential. Still, it differs from the distinction between private knowledge and public knowledge. "Private knowledge" is the individual's intimate knowledge. These are thoughts on contents known only to the individual, such as intimate dreams and feelings, "hidden agenda" (i.e. hidden goals and incentives). "Public knowledge" refers to thoughts that the individual consider as knowledge, and they are on contents known to other people as well (e.g. "$2 + 2 = 4$", "Paris is the capital of France").

In the second stage, I shall discuss the relationship between these two modes of knowledge. The two modes of knowledge – as a thought and as an object – are interrelated. In fact, objective knowledge is an external subjective knowledge. Furthermore, the realization of objective knowledge necessitates subjective knowledge; meaning that objective knowledge becomes real and meaningful only to the individual who is aware of it by his or her own subjective mind.

In the third stage, I shall analyze the three key concepts "data", "information", and "knowledge", and the relations among them. Each of these concepts will get two parallel meanings – one in the subjective domain and one in the objective, or rather collective, domain. Next, in the fourth stage, I shall argue that information science deals with the meta-knowledge of objective knowledge, particularly in its mediatory and technological aspects. Finally, in the last phase, I shall suggest changing the name of the field from "information science" to "knowledge science". This is the outline of the philosophical argumentation. Now, let us study it in detail.

Meanings of "knowledge"

Types of knowledge

In traditional epistemology, there are three main kinds of knowledge: practical knowledge, knowledge by acquaintance, and propositional knowledge (Bernecker and Dretske, 2000). Practical knowledge, which is usually known as "knowing how", refers to skills. Skills are functional abilities (e.g. riding a bike, and driving a car). The distinction between knowledge by acquaintance and propositional knowledge, which is also known as descriptive knowledge, was initially offered by Russell (1912). Knowledge by acquaintance is direct non-mediated knowledge of objects. This is the knowledge that a person has of external physical objects and organisms, by means of direct sense data, or the direct knowledge about his or her own self (e.g. pain, hunger). Propositional knowledge usually comes in the form of "knowing that" S (subject) knows that P (proposition). It is the reflective and/or the expressed content of what a person thinks that he or she knows. Note that the contents of our reflective and/or expressed thoughts are in the form of propositions. Propositional knowledge is divided into inferential and non-inferential knowledge. Non-inferential propositional knowledge refers to direct intuitive knowledge. For example, we often use general abstract terms, such as "information", "knowledge", "love", "justice", "soul", and "God". Usually we understand these expressions intuitively. When we define the terms and draw some conclusions that are based on them, our non-inferential knowledge turns into inferential knowledge. Inferential knowledge is a product of inferences, such as induction and deduction.

The field of information science, as well as any academic field, is composed of inferential propositional knowledge. In fact, this paper, as well as any scientific paper, is composed of inferential propositional knowledge. It starts with a proposition and then develops it layer upon layer until it reaches its final conclusion. This analysis is focused on knowledge as inferential propositional knowledge. Furthermore, information science, as well as any scientific field, is a product of social construction, composed of inferential propositional knowledge. It is grounded on some fundamental publications and has been developed layer upon layer until it reaches its most recent state. In fact, this article is one link in a continues and ever changing chain called "information science".

Subjective knowledge vs objective knowledge

Still, what is knowledge? There are two basic approaches to define the concept of "knowledge", knowledge as a thought in the individual's (or subject's) mind, and knowledge as an object or a thing. The first approach conditions the knowledge in the individual's mind. Knowledge is a thought. It is characterized as "a justified true belief". This definition of knowledge as a justified true belief is originated from Plato's (1999) *Theaetetus*. According to Bernecker and Dretske(2000) in traditional epistemology there are three individually necessary and jointly sufficient conditions to propositional knowledge: justification, truth, and belief. The epistemological literature has thoroughly debated these conditions (e.g. Gettier's, 1963; Lehrer, 1997; Audi, 2003). Gettier in his influential paper posited a hypothetical situation intended to question the definition of knowledge as completely justified true belief, and to argue for a softened position. Still, without delving into the epistemological literature, it seems sufficient for our purposes to characterize subjective propositional knowledge by the

certainty of the individual that his/her own thoughts are true, and his/her ability to base this certainty on a sound justification. Note that in the subjective domain "knowledge" is the content of a justified true thought in the individual's mind, while "knowing" is the state of mind, which is characterized by the three conditions: justification, belief, and truth.

The second approach ascribes an independent objective existence to knowledge. Knowledge is the meaning, which is represented by expressed propositions. It is true and exists independently of, not depending on, subjective knowledge of the individual knower. The implications of this approach to LIS were recently discussed by Hjørland (2004).

Karl Popper's "worlds"

The reader who is familiar with the philosophy of Karl Popper might find a resemblance between the two approaches to defining "knowledge" and the concepts "world 2" and "world 3." Popper (1967, 1972, 1977) differentiates among three types of objects, or "worlds" according to his terminology. "World 1" is composed of all the physical entities. "World 2" is composed of all the subjective entities, including knowledge as a thought in the subject's mind. "World 3" is composed of all the products of the human mind, including knowledge as an independent object. Following Popper, one can say that the objective knowledge (namely "world 3") is documented, saved, and transmitted by means of physical objects, such as books, paper, and CDs (namely "world 1"), and becomes real to each one of us only as each one of us gets to know it through his or her own mind (namely "world 2").

Ontological status of knowledge

Generally, there are three distinct positions regarding the ontological status of "world 3" entities. Popper, as well as many other scholars, holds a metaphysical standpoint that ascribes an independent ontological status to entities of world 3. According to Popper, objective knowledge exists independently, not depending on subjective minds. As opposed to this metaphysical standpoint, other scholars claim that objective knowledge is totally dependent on subjective minds. From an epistemological perspective, the two rival positions, "knowledge is an independent object" and "knowledge is not an independent object" have the same epistemological status. Both are metaphysical assertions. Epistemologically, they are similar to the two religious assertions "God exists" and "God does not exist". Yet, there is a third option, an agnostic stand point, which means "I don't know".

Universal knowledge

According to the agnostic standpoint, I really do not know if objective knowledge exists outside my own subjective mind. Although I ascribe independent validity to the concept of objective knowledge, which is binding for every person who becomes aware of it, I do not know if it really exists as an independent object outside my mind. This is crucial, ascribing objective or universal validity to knowledge does not mean that it is true, since the knowing person – the one who ascribes universal validity to knowledge – might be wrong. For this reason, we should refine our terminology and replace "objective knowledge" with "universal knowledge", or "inter-subjective knowledge" to characterize knowledge in the collective domain.

Complementary approaches

The subjective and the objective, or rather universal, diverse approaches are paradoxically complementary, since universal knowledge that no one knows is meaningless, and since universal knowledge is a product of subjective knowledge.

Mr and Mrs Jones. Let us examine two imaginary examples, taken from the realm of poetry and the realm of science. Mr Jones is a poet. Every day he composes a poem. His poems reflect his feelings, memories, vivid imagination, and rich inner world. Mr Jones customarily articulates his poems in his "head", memorizing them word by word. He never writes his poems. Actually, once he did. He wrote a poem on a piece of paper (a napkin, to be precise), and then he realized that his written poem was no more than a concise version of his original inner poem, and only insinuated – but did not really reflect – his rich inner world. He discovered that each time he read his own poem he understood it differently. Suddenly, he realized that written words are codes that represent thoughts. He knew that people who read his poem would never be able to understand it the way he did. Nevertheless, he happily went to sleep, but not before giving his wife, the scientist Mrs Jones, a goodnight kiss. In the morning, he was horrified to discover that he had forgotten the poem. He looked for the napkin, but he had misplaced it. Unfortunately, he never found it. When Mr Jones told his wife, the scientist Mrs Jones, what had happened, she remembered that a few days earlier, she had mislaid a napkin with her greatest scientific discovery written on it, and she too could not recall it. Does Mr Jones' mislaid poem really exist? Does Mrs Jones' mislaid scientific discovery really exist?

One can answer these questions assuming metaphysical assumptions on the ontological status of different types of entities (like Karl Popper, for instance). I prefer to remain on the practical level. There is no meaning to knowledge that no one knows. We always know the objective through our subjective minds. Meaning is formed subjectively by individuals. To summarize this point: paraphrasing the French philosopher Rene Descartes we can say that each person should validate universal knowledge using his or her own subjective mind.

Furthermore, if one sticks to a practical approach, rather than to a religious or metaphysical approach, one must admit that universal knowledge is a product of the externalization of subjective knowledge. In fact, universal knowledge can be characterized as recorded, documented, or physically expressed subjective knowledge.

Symbols vs meaning

There is a fundamental distinction between documented (i.e. written, spoken, or physically expressed) propositions and meanings. "$E = MC^2$", "$\underline{\mathrm{E} = \mathrm{MC}^2}$", and "$\mathbf{E = MC^2}$" are not three different types of knowledge. These are three different sets of symbols (or characters) that represent the same meaning. In other words, they are three different utterances of the same knowledge. Knowledge, in the collective domain, is the meaning that is represented by written and spoken statements (i.e. sets of symbols). However, since we cannot perceive with our senses the meaning itself, we can relate only to the sets of symbols (i.e. written, spoken, or physically expressed propositions), which represent it. Apparently, it is more useful to relate to "knowledge" as sets of symbols rather than as meaning.

Data, information, and knowledge

Having established the distinction between the subjective and the universal domains, we are in a position to define the three key concepts "data", "information", and "knowledge". In fact, we have six concepts to define, divided into two distinctive sets of three. One set relates to the subjective domain, and the other – to the universal domain. Note that the academic and professional IS literature supports diversified meanings for each concept (see for example, Capurro and Hjørland, 2003; Machlup, 1983).

More then 20 years ago Machlup (1983) wrote on the concept of data:

> The use and misuse of the term data is due, in part, to linguistic ignorance. Many users do not know that this is a Latin word: *dare* means "to give"; *datum*, "the given" (singular); and *data*, "the givens" (plural). Data are the things given to the analyst, investigator, or problem-solver; they may be numbers, words, sentences, records, assumptions – just anything given, no matter what form and of what origin. This used to be well known to scholars in most fields: some wanted the word data to refer to facts, especially to instrument-readings; others to assumptions. Scholars with a hypotheti-co-deductive bent wanted data to mean the given set of assumptions; those with an empirical bent wanted data to mean the records, or protocol statements, representing the findings of observation, qualitative or quantitative. With this background of historical semantics, a reader of recent definitions of, or statement about, data cannot help being appalled.

This is applicable to the use and misuse of the concepts of information and knowledge as well. In this essay, I shall not review the various definitions supported by the literature, but rather, I shall stipulate six generic definitions, coherent with the philosophical analysis presented here.

"Data", "information", and "knowledge" are interrelated. Discussions among scholars focus on the nature of the relations among these key concepts, as well as on their meanings. Generally, the three concepts are conceived as part of a sequential order: data, information, knowledge. Data (c.f. the plural form of the Latin word *datum*, which means "the given") is the raw material for information, and information is the raw material for knowledge. However, this sequence seems problematic, since it is based on the assumption that information is a necessary element, embodied in knowledge; an intermediate stage between data and knowledge. It is not. Furthermore, the alternative view that claims that "information" and "knowledge" are synonyms is problematic too. Information and knowledge are not synonyms. Information is a specific type of knowledge.

The subjective domain

In order to evaluate the definitions of the three concepts in the subjective domain properly the reader should be aware of some basic epistemological discussions. Note that knowledge – as a thought – is a product of a synthesis. This assertion is based on the philosophical literature that followed Kant's (1781) *Critique of Pure Reason*. Kant argued that any empirical perception is the product of a synthesis of a multiplicity of sense/sensory data. He identified in any perception a priori components, which give meaning to the diversity of raw material and construct it as one unit. To demonstrate this key assertion that any empirical perception is a product of a synthesis let us return to Mr Jones.

Mr Jones is sitting in his room composing one of his poems. Suddenly, he hears a series of noises that come through the closed window, and he concludes that his wife,

Mrs Jones, has just started her car, though he cannot see her. He continues to listen and hears his wife drive the car off.

Now, let us see what actually happened. Mr Jones' ears perceived a series of sensory data. In his mind, he associated each noise with a specific object – his wife's car. Once the noises were identified as associated with the same object, they were composed to form a unified perception, which represents the condition of the car in a time sequence: engine off – engine on – car moving.

The same happens with visual impressions. The pictures that I see are a synthesis of the visual impressions that I have. I am presently looking at my computer monitor. Then I close my eyes, and instantly open them. I still see a computer monitor in front of me. Is it the same computer monitor that I saw a moment before? In fact, I had two different images of monitors, one before I closed my eyes and one after I opened them. In my mind, the two images assembled to form one picture of the same monitor.

This analysis of the temporal continuity of multiple impressions of a single thing follows the analysis undertaken by the British philosopher David Hume, who preceded Kant. Hume identified the problem: the limitation of empirical perception. He showed that we cannot actually see that it is the same object. Hume questioned the two basic concepts of "identity" and "causality", and shook the foundations of science. Kant formulated the solution: every empirical perception is a product of a synthesis of the diverse sensory data (or impressions) into one unit in the subject's mind. Every empirical perception is composed of these two basic components: the empirical sensory impressions, namely, what we perceive through our senses, and the a priori concepts, by which these impressions acquire meaning and are composed into one unified thematic unit. For the reader who is familiar with the relevant epistemological literature, it is important to clarify that I follow Kant's principle of a priori knowledge, without adopting his suggested a priori categories.

"Data" is the sensory stimuli, which we perceive through our senses. "Information" is the meaning of these sensory stimuli (i.e. the empirical perception). In the example above, the noises that Mr Jones' ears heard are data. The meaning of these noises (i.e. a running car engine) is information. Still, there is another alternative as to how to define these two concepts – which seems even better. "Data", in the subjective domain, is the sense stimuli, or their meaning (i.e. the empirical perception). Accordingly, in the example above, the loud noises, as well as the perception of a running car engine, are data.

"Information", in the subjective domain, is empirical knowledge. Accordingly, in the example above, the knowledge that the engine is now on is information, since it is empirically based. The reader might claim that information is a certain type of empirical knowledge, namely it is empirical knowledge that adds new knowledge to the individual's previous knowledge. For example, if a science teacher teaches a scientific truth, the same statement is information for the student, since it adds new empirically based knowledge to his or her previous knowledge, while for the teacher it is knowledge. In order to avoid such complications, let us define "information" as any type of empirical knowledge. As one can see, information is a type of knowledge, rather than an intermediate stage between data and knowledge.

"Knowledge", in the subjective domain, as noted, is a thought in the individual's mind, which is characterized by the individual's justifiable belief that it is true. It can

be empirical and non-empirical, as in the case of logical and mathematical knowledge (e.g. "every triangle has three sides"), religious knowledge (e.g. "God exists"), philosophical knowledge (e.g. "*Cogito ergo sum*"), and the like.

The universal domain

Data, information, and knowledge are represented, in the universal domain, by empirical symbols (i.e. symbols that on can sense through his/her senses). They can take on diversified forms such as engraved signs, painted forms, printed words, digital signals, light beams, sound waves, and the like. As noted, objective knowledge, or rather universal knowledge, is a product of an externalization of subjective knowledge. Consequently, objective data, objective information, and objective knowledge mirror their cognitive counterparts. Meaning, in the objective domain "data" are sets of symbols, which represent empirical stimuli or perceptions. "Information" is a set of symbols, which represent empirical knowledge. "Knowledge" is a set of symbols, which represent the meaning (or the content) of thoughts that the individual justifiably believes that they are true.

The individual knower is a key factor in determining whether a set of symbols represents data, information, or knowledge, or whether it is meaningless. This is crucial; a person has to be knowledgeable on the subject matter, or rely on an authoritative resource (e.g. physicians, medical reference sources, etc.). When a physician spots red spots on his/her patient's arm, and calls his/her attention, both of them have medical data. The red spots lead the physician to conclude that the patient is allergic. The statement "you are allergic" is medical information for both of them. However, while the physician bases the diagnosis on his/her own medical knowledge; this same medical knowledge is unknown to the patient, who has to rely on the physician.

Very often, the contents (i.e. data, information, or knowledge) handled by information systems are coded. The individual knower has to understand the meaning of coded sets of symbols, or justifiably believe that they are reliable and meaningful. Still, the content should be verifiable. This is usually the case regarding digital information stored in information systems. Although the user cannot directly perceive the data stored in the hardware through their senses, they can reasonably believe that the hardware does store meaningful contents.

Information science

Based on the conceptual analysis of "data", "information", and "knowledge" we can conclude that these key concepts have six distinctive coherent meanings; divided into two distinctive sets, a subjective set of meanings, and an objective set. Still, what is the focal domain of information science?

One might claim that information science is focused on the subjective domain. If this is the case, then we are required to formulate a clear distinction between the foci of cognitive sciences and neurosciences and the foci of information science. Clearly, information science has different foci. While cognitive psychology and neurosciences are focused on the subjective domain, by exploring thinking and learning, information science concentrates on the objective domain. This is the only way to explain the inclusion of library science, documentation, knowledge organization, information

retrieval, and information systems within the boundaries of the information science knowledge domain.

To be precise, information science is focused on the meta-knowledge aspects of objective knowledge, particularly on its technological and mediatory aspects. It explores the phenomena, objects, and conditions that facilitate the accessibility to knowledge. It belongs to a group of fields, which establish the meta-knowledge foundations of human knowledge. These are epistemology, philosophy of science, sociology of knowledge, methodology of science, and information science. Epistemology is the branch of philosophy that explores the possibility of knowledge, and seeks to formulate a theory of knowledge. Philosophy of science is the branch of philosophy that explores the theoretical, methodological, and historical perspectives of science. Sociology of knowledge is the branch of sociology that explores the sociological aspects of knowledge, including the social origins of ideas, and their effects on societies. "Methodology of science" does not exist *per se*, but rather it is a collection of methodological studies, taken from all branches of knowledge, aimed at exploring, developing, and evaluating scientific research methodologies. Finally, information science is the branch of knowledge that studies the technological and mediatory aspects of objective knowledge, namely, the production, representation, organization, processing, storing, dissemination, and retrieval of knowledge.

This conception is reflected in the working definition, adopted by *Information Science Abstracts* (ISA) journal and database (Hawkins, 2001). Information science is:

> An interdisciplinary field concerned with the theoretical and practical concepts, as well as the technological, laws, and industry dealing with knowledge transfer and the sources, generation, organization, representation, processing, distribution, communication, and uses of information, as well as communications among users and their behavior as they seek to satisfy their information needs (Hawkins, 2001).

Generally, ISA's working definition is coherent with the conception of information science presented in this paper, though some revisions are required. First, information science deals with the environmental (i.e. social; including laws, norms, ethical codes, etc), organizational (i.e. related to the relevant organizations (e.g. libraries, schools, hospital, etc.)), content related, and technological aspects of knowledge.

Second, information science and its concern with "industry" is not so clear. The term "knowledge industry" is applicable to a wide range of organizations dealing with knowledge. It is applicable to kindergartens, elementary schools, universities, research institutions, TV stations, as well as archives, museums, libraries, information services, and hi-tech companies. "The industry" has a common denominator. It deals with the production, the storage, or the dissemination of knowledge. Still, the term is too broad to capture the essential differences between organizations, which deal with different fields, such as education, media, culture, and the like. Many industries (e.g. education industry, health industry, media industry) include organizations that belong to the knowledge industry. Using the term "knowledge industry" necessitates refining its meaning. Note that the term "knowledge industry" is a generic term. It has at least five theoretical foundations: technology, economics, information science, sociology, and the content related disciplines (e.g. medicine, education, chemistry, geography, etc.). Therefore, it can be studied in at least five different contexts.

Third, information science is not concerned with the uses of information. This is the province of the various disciplines. Information professionals do not use, for instance,

medical information to treat their clients. Physicians do. Information professionals store, retrieve, and transmit medical information; they do not use it. Furthermore, their role in generating medical information is very limited. In fact, it is limited to some contributions of mediatory and technological aids.

The notion that information science explores the mediatory and technological foundations of objective knowledge is also reflected in the table of contents of the *Information Science Abstracts* (2002) (see Figure 1), and in the facet list of *ASIS Thesaurus of Information Science and Librarianship* (Milstead, 1998, see Figure 2). Most of the subjects included in these schemes are coherent with this conception, though some adaptations are required. This is true regarding "user behavior" and "information literacy" (see Figure 1), as well. Note that although user studies often relates to the user's cognition too, its prime interest is limited to the user's accessibility to knowledge.

1. Information Science research.
1.1 Basic concepts, Definitions, Theories, Methodologies, and Applications.
1.2 Statistics, Measurement.
1.3 Information Retrieval Research.
1.4 User Behavior and Uses of Information Systems.
1.5 Human – Computer Interface.
1.6 Communication.
1.7 History of Information Science, Biographies.
2. Knowledge Organization.
2.1 Thesauri, Authority Lists.
2.2 Cataloging and Classification.
2.3 Abstracting, Indexing, Reviewing.
2.4 Standards and Protocols.
3. The Information Profession.
3.1 Information Professionals.
3.2 Organizations and Society.
4. Societal Issues.
4.1 Information Ethics, Plagiarism, Credibility.
4.2 Information Literacy, Lifelong Learning.
4.3 The Information Society.
5. The Information Industry.
5.1 Information and Knowledge Management.
5.2 Markets and Players.
5.3 Marketing, E-Commerce.
6. Publishing and Distribution
6.1 Electronic.
6.2 Scholarly Communication.
7. Information Technologies.
7.1 Internet.
7.2 Intranets (Private), Web Conferencing.
7.3 Software.
7.4 Hardware.
7.5 Multimedia.
7.6 Document Management.
7.7 AI, Expert Systems, Intelligent Agents.
7.8 Telecommunication.
7.9 Security, Access Control, Authentication, Encryption.
8. Electronic Information Systems and Services.
8.1 Information Searching and Retrieval System and Services.
8.2 Customized Information Systems, Alerting, Current Awareness.
8.3 Documents Delivery Systems and Services.
9. Subject – Specific Sources and Applications.
9.1 Physical Sciences.
9.2 Life science.
9.3 Social Sciences, Humanities, History, Linguistics.
9.4 Business.
9.5 Law, Political Science, Government.
9.6 Education, Library and Information Science, Ready Reference.
9.7 Other/Multidisciplinary.
10. Libraries and Library Services.
10.1 Library Descriptions and Types.
10.2 Library Services.
10.3 Library Automation, Operations, and Planning.
10.4 Digital and Virtual Libraries, Hybrid Libraries.
10.5 Education and Training.
11. Government and Legal Information and Issues.
11.1 Intellectual Property Protection.
11.2 Legislation, Laws, and Regulations (Except Copyright).
11.3 Liability Issues.
11.4 Sources of Public Information.
11.5 Information Policies and Studies.
11.6 System and Infrastructure.

Figure 1.
Information Science Abstracts – table of contents

Note: The order of the sections is similar to the original order, but the numbers of the sections might be different

1. Activities and Operations
- 1.1 Business and Management Operations.
- 1.2 Communications Activities.
- 1.3 Computer Operations.
- 1.4 Educational Activities.
- 1.5 General Activities.
- 1.6 Information and Library Operations.
- 1.7 Socioeconomic Activities.
- 1.8 Technical and Manufacturing Operations.

2. Buildings and Facilities.
3. Communications Media.
4. Document Types.
- 4.1 By Availability, Access, Organization.
- 4.2 By Information Content, Purpose.
- 4.3 By Medium, Physical Form.

5. Fields and Disciplines.
6. Hardware, Equipment, and Systems.
7. Knowledge, Information, etc.
- 7.1 By Content.
- 7.2 Information Representations.
- 7.3 Knowledge and Information Organization Devices.
- 7.4 Languages.
- 7.5 Linguistic elements.

8. Natural Functions and Events.
9. Network.
10. Organizations.
11. Persons and Informal Groups.
12. Physical Media.
13. Product and Service Providers.
14. Qualities.
- 14.1 General Qualities.
- 14.2 Human Qualities.
- 14.3 Qualities of Information and Data.
- 14.4 Qualities of System and Equipment.

15. Research and Analytic Methods.
16. Sociocultural Aspects.

Note: The order of sections is similar to the original order, but there are no numbers in the original chart

Figure 2.
ASIS Thesaurus of Information Science and Librarianship – facet list

The two schemes stress the interdisciplinary nature of information science. "Information science" is a generic name of an interdisciplinary field. It is a warehouse of fields related to information and knowledge. Still, many fields that historically were included under the auspices of "information science" were separated after they reached some substantial volume and gained recognition of independent fields. I envision that in the near future this will happen to some of the subfields listed in the two schemes.

Knowledge science

At this point, we can conclude that information is a type of knowledge, and information science explores the foundations of knowledge, as well as the foundations of information. Consequently, the name "knowledge science" seems to capture the essence of the field better than its current name "information science". It seems that the time has come to replace the latter with the former.

This philosophical essay is aimed at analyzing the conception of information science. It is based on clarifying the meanings of its basic concepts "data",

"information", and knowledge". The discussion is culminated in the suggestion to change the name of the field from "information science" to "knowledge science". Evidently, changing the name of the field reflects the conception that current information science is primarily focused on exploring the mediating aspects of human knowledge. The name of the field was changed in the past (see Hahn and Buckland, 1998), and it probably might be changed in the future.

The former name of the field, "Documentation", its current name, "Information Science", and the suggested name, "Knowledge Science", reflect the same position regarding the explored phenomenon of the field, namely, information and knowledge, mutatis mutandis, in the objective domain, or rather collective domain.

Furthermore, the current name "information science" is based on the following rationale: knowledge is a product of a synthesis in the human mind, and exists only in the subjective domain (i.e. as a thought in the subject's mind). Its manifestation in the objective domain is not "knowledge" but "information". Since our field is focused on information (i.e. as an entity in the objective domain), it should be called "information science" rather than "knowledge science". Since I share the same position regarding the focus of the field on the objective domain, while arguing that knowledge does exist in the objective domain, and what proponents of "information science" call "information" I call "knowledge in the objective domain", I suggest calling the field "knowledge science" rather than "information science".

I would like to share with the reader my reflections on the explored phenomena of information science. Ten years ago when I first thought about this field of study it was clear to me that the explored phenomena of information science happens to be information. When I started working on this paper I was convinced that IS explores knowledge, and that we should redefine "information science" as "knowledge science". Recently, I went one step forward towards the message phenomena. Note that "message" is defined here in its broadest sense (i.e. as meaningful content) rather than in the narrow sense of a sender-recipient phenomenon. A few days ago, I received the latest issue of the *Journal of the America Society for Information Science* (Vol. 55 No. 12), which is dedicated to *music* information retrieval. The various papers make it clear: current information scientists explore the retrieval of information and knowledge on music (music information/knowledge retrieval), and the retrieval of music *per se* (music retrieval). Apparently, information scientists do explore messages (i.e. meaningful contents). It seems that *information science* is turning slowly into *message science*, or rather *content science*.

Conclusion

This philosophical essay has explored the conception of information science. The philosophical argumentation was composed of five stages. First, I differentiated between subjective knowledge and objective knowledge, or rather universal domain. Then, I discussed the relationship between these two modes of knowledge, and demonstrated their mutual dependency. On the one hand, universal knowledge is externalized, recorded or documented, subjective knowledge. On the other hand, the realization of universal knowledge necessitates the consciousness of at least one knower.

In the third phase, I analyzed the three key concepts "data", "information", and "knowledge". Each of these concepts got two parallel meanings. Universal data,

universal information, and universal knowledge mirror their cognitive counterparts. In the universal domain, "data" is a set of symbols that represent empirical perceptions or empirical raw material. "Information" is a set of symbols that represent empirical knowledge. "Knowledge" is a set of symbols that represent thoughts, which the individual justifiably believes that they are true. In this analysis, information is a type of knowledge. It is neither an intermediate stage between data and knowledge, nor a synonym for knowledge.

Next, in the fourth phase, I argued that information science is focused on the foundations of objective knowledge, particularly in its mediatory and technological aspects. It is part of a group of fields, together with epistemology, philosophy of science, sociology of knowledge, methodology of science, and information science, that establish the meta-knowledge of human knowledge. Finally, in the last stage, I suggested that the name of the field that is designated as "information science" should be changed to "knowledge science".

As the field of information science has reached maturity, it enters into an age of reorganization. I envisage that in the next decade information science – or rather, knowledge science – research will focus on exploring the conceptions of the field, and reestablishing the boundaries of its knowledge domain.

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