Conceptions of Information Science

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The field of information science is constantly changing. Therefore, information scientists are required to regularly review—and if necessary—redefine its fundamental building blocks. This article is one of four articles that documents the results of the Critical Delphi study conducted in 2003–2005. The study, "Knowledge Map of Information Science," was aimed at exploring the foundations of information science. The international panel was composed of 57 leading scholars from 16 countries who represent nearly all the major subfields and important aspects of the field. In this study, the author documents 50 definitions of information science, maps the major theoretical issues relevant to the formulation of a systematic conception, formulates six different conceptions of the field, and discusses their implications.

Introduction

The field of information science (IS) is constantly changing. Therefore, information scientists are required to regularly review—and if necessary—redefine its fundamental building blocks. This article is one of four articles that documents the results of the Critical Delphi study conducted in 2003–2005. The study, "Knowledge Map of Information Science," explores the theoretical foundations of information science. It maps the conceptual approaches for defining data, information, and knowledge (Zins, in press-a), maps the major conceptions of information science, which are presented here, portrays the profile of contemporary information science by documenting 28 classification schemes compiled by leading scholars during the study (Zins, in press-b), and culminates in developing a systematic, scientifically grounded and theoretical map of the field (Zins, in press-c).

The concept of information science, which is the focus of this article, is a constitutive concept. It shapes the boundaries of the information science knowledge domain and its focal perspectives. For this very reason, formulating a systematic conception of information science is crucial for the formulation of a systematic and comprehensive knowledge map of the field.

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Information Science

What is the essence of information science? The quest for identity is explicit in numerous studies and position articles (e.g., Debons, Horne, & Cronenworth, 1988; Hawkins, 2001; Hjørland, 1998), overviews of the history and the foundations of the field (e.g., Buckland, 1999; Buckland & Liu, 1995; Ingwersen, 1995), and 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, Capurro & Hjørland, 2003, and the overviews of Boyce & Kraft, 1985).

Apparently, there is not a uniform conception of information science. The field seems to follow different approaches and traditions; for example, objective approaches versus cognitive approaches, and the library tradition versus the documentation tradition versus the computation tradition. The concept has different meanings, which 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 scholars, practitioners, and students are confused.

Information Science Versus Knowledge Science

Furthermore, even the name *information science* is problematic. The three concepts, data, information, and knowledge that are embodied in the concept of information science are interrelated. 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 information science. Note that knowledge science can explore knowledge and its building blocks, information and data, whereas information science is hindered from exploring knowledge because it is of a higher order.

This article is focused on exploring the meaning of information science as it is understood by leading scholars in the information science academic community.

Methodology

The scientific methodology used was Critical Delphi. Critical Delphi is a qualitative research methodology aimed

at facilitating critical and moderated discussions among experts (the panel). The international and intercultural panel was composed of 57 participants from 16 countries—leading scholars representing nearly all the major subfields and important aspects of the field (see Appendix A). The indirect discussions were anonymous and were conducted in three successive rounds of structured questionnaires. The first questionnaire consisted of 16 pages comprised of 24 detailed and open-ended questions. The second questionnaire contained 18 questions in 16 pages. The third questionnaire contained 13 questions in 28 pages (see relevant excerpts from the three questionnaires in Appendix B). The return rates were relatively high: 57 scholars (100%) returned the first round (R1), 39 (68.4%) returned the second round (R2), and 39 (68.4%) returned the third round (R3). Forty-three panelists (75.4%) participated in two rounds, and 35 panelists (61.4%) participated in all three rounds. In addition, each participant received his or her responses for review before my citation of them in future publications. The responses were sent to the each panel member with relevant critical reflections. Forty-seven participants (82.4%) responded and approved their responses. Twenty three of them, which is 48.9% (23 out of 47), and 40.3% of the entire panel (23 out of 57) revised their original responses. Therefore, one can say that actually the critical study was composed of four rounds. The time frame of the study was October 1, 2003 through October 30, 2005.

The Panel's Definitions

Forty-nine panel members contributed their definitions and reflections on information science. A citation number is given at the end of the quotation to facilitate reference in the text of the article.

> Information Science is concerned with design and use of information systems for mediation of knowledge. (Hanne Albrechtsen [1])
>
> Information Science is the study of the functions, the structure and the transmission of information and the management of information systems. It is the study of data, information, knowledge, and message, as they exist in the collective domain, explores only the mediating aspects, focuses in hi-tech and included user studies." (Elsa Barber [2])
>
> Information science is the study of production, organization, control, and use of information in any support and going through any channel. It is the study of the rare and surprisingly phenomena of the transformation of information into knowledge that occurs in an individual mind. (Aldo Barreto [3])
>
> Information science explores the methods for allocation, organization, analysis, and dissemination of information, and the human and the technological tools appropriate for these purposes. It is the study of the technological and the social process that occurs while changing data to message. (Shifra Baruchson-Arbib [4])
>
> Information Science is the study of data, information, knowledge and message (however defined and in whatever relation to each other) in relation to human behaviour and use. (Clare Beghtol [5])
>
> Information Science, as well as Library Science, is a discipline concerning theories, methodologies and procedures elaborated to individuate, organize, and disseminate the knowledge contained in books and documents, in whichever form, and to connect the knowledge recorded in the external memories (documents and books) with the human mind. In a broad sense, Information and Library Science is part of a general Science of Communication, meaning Communication as a connection between external memories and cognitive system or knowing subject. (Maria Teresa Biagetti [6])
>
> **Definition.** Information science is the field formerly known as "Documentation", and now commonly referred to as "Information Science." My definition would be that it is, broadly, concerned with the creation, dissemination, and utilization of knowledge. Within that broad scope there tend to be two sub-areas: a wide-ranging concern with human and social aspects: information related behavior, organizational and social concerns; and a technical/engineering concern with the design and evaluation of information systems.
>
> **Three conceptions.** There is not one Information Science, but multiple different views of Information Science. One is the "Message Science" which is a recognition/rediscovery of the primary historical basis of I.S: Documents and Documentation from 1880s onwards. Another is a more general information science that attempts to include all of D-I-K-M. A third is an IT-constrained view that is anchored in digital technology. (Michael Buckland [7])
>
> Information Science is the study of all aspects of the management of information (e.g., research, creation of IT systems, storage, change, deletion, it's handling actualization, tools for development, handling, administration, information about information, introduction to end-users, etc.) (Manfred Bundschuh [8])
>
> Information science is the study of the mediating and technological aspects of information accumulation, publication, communication and interpretation. (Quentin L. Burrell [9])
>
> Information Science in a narrower sense is the study of messages within the context of human communication, which implies the process of meaning offer (i.e., message), meaning selection (i.e., information) and understanding. In a broader sense it is the study of messages in non-human phenomena.
>
> In my view information science should take the phenomenon of message as its core perspective. I use the word 'angeletics' (originating from the Greek word for message = 'angelia,' not a science of 'angels' or angelology!) for pointing to a field of study that should include the process of selection, i.e., traditional information retrieval, as well as understanding or information science hermeneutics (Capurro, 2000).
>
> Message and information are related but not identical concepts. A message is sender-dependent, i.e., it is based on a heteronomic or asymmetric structure. This is not the case of information: we receive a message, but we ask for information. A message is supposed to bring something new and/or relevant to the receiver. This is also the case of information. A message can be coded and transmitted through different media or messengers. This is also the case of information. A message is an utterance that gives rise to the receiver's selection through a release mechanism or interpretation. (Rafael Capurro [10])

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Information Science is the study of information acquisition, identification, storage, representation, transference, and use. (Thomas A. Childers [11])

Information science is an interdisciplinary field encompassing all aspects of data from data generation via measurement and observation, through data capture, analysis, representation, organization, evaluation, storage, transformation, presentation, protection, and retention. Note that 'Data' can be used as a collective noun in English. As such it can and should be used to imply a set of symbols, and would be preferable to using 'information' in such a narrow context (Rush & Davis, 2006). (Charles H. Davis [12])

Information science is that area of study and practice which attempts to determine the laws and principles pertaining to the analysis, design and evaluation of Data, Information and Knowledge Systems. It is based on the following rationale: All organisms are data, information, and knowledge systems, varying in the degree with which they can process these cognitive/affective functions. Each of these functions are aided and augmented by technology that each species generate, invent, and apply.

The human Organism is a DIK system. It is limited in its capacity to respond to the demands of the physical world and its constituents (society, technology, culture. etc). Due to this limited capacity it seeks to augment this capacity through technological and sociological (e.g., political, economic) arrangements. The business of information science is to find the laws, and principles that can integrate these essential properties.

The forms of technology that I have reference are extensive and many, including the abacus, ink, pen, rock, blackboard, eyeglass, hearing aid, computers, etc. This includes institutions like schools, libraries, newsprint, journals, etc. (Anthony Debons [13])

Information science is the science concerned with manipulating (gathering, storing, retrieving, classifying, interpreting) information and understanding its underlying mechanisms. (Gordana Dodig-Crnkovic [14])

Information Science explores the ways to mange data for creating information, to manage information, and to understand their meaning to create knowledge. (Henri Jean-Marie Dou [15])

Information Science is the science of information systems. It studies the information (as a process, as a product or as a state of awareness) as well as its five basic sub-processes—generation, processing, communication, storage, and use—in order to optimize them (note that all these processes are being time and resources dependent). Its goal is to facilitate the knowledge transmission from a person to another and from a generation to another, in order to accelerate the progress of mankind (Dragulanescu, 2004). (Nicolae Dragulanescu [16])

Information Science is the field concerned with the collection, organization, storage, retrieval, and dissemination of information. Information is a product of human intellect fixed in tangible form. (Carl Drott [17]).

Information science is a mathematical discipline that studies technological ways of conveying information. (Luciana Duranti [18])

Information science is composed of theoretical and applied efforts to define information, how it may be processed with computers and affiliated technologies (i.e., information systems), and how such information and systems may interact with specific human practices and studies, such as business, culture, library science, philosophy, etc. (See Buchanan, 2001; Ess, 2003, 2004; Tavani, 2004, for further discussion). (Charles Ess [19])

Information science is the study of the interaction between humans and information and all the mechanisms and elements of context that play a role in this interaction. (Raya Fidel [20])

Information science is that field of inquiry that deals with information systems, so that it can provide access to information in an effective and/or efficient manner (Taylor, 1986). Information science is fundamentally about practice—building, improving, designing implementing systems and servicing that meet the needs of users—that is where it starts and that is where it ends. (Thomas J. Froehlich [21])

Information science is the study and practical management of messages (i.e. recorded information, including data recorded as information) through all points of the information life cycle. (Alan Gilchrist [22])

The name 'information science' is a self-serving attempt to ennoble what used to be called 'library science.' (H.M. Gladney [23])

Information Science is the study of systems phenomena, their information subsystems and processes and their interrelations through different environmental contexts. This definition would apply to the molecular and cellular levels or to organ, organism, group, community or higher levels. **Information technology** is concerned with optimal information handling and processing, usually for given individuals or organizations, and usually for human applications. **Bioinformatics** has recently extended information science to the rest or the animal and plant kingdoms (see Travis, 2003). (Glynn Harmon [24])

Information science is an interdisciplinary field concerned with the **theoretical** and **practical** concepts, as well as the technologies, 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. (Donald Hawkins [25])

Information science is the study of information in all its manifestations. Although attention is directed traditionally to information storage and retrieval—including library systems, classification schemes, indexing and abstracting, catalogs, as well as search engines, concept mapping, studies of relevance and retrieval—this expands to include user search and retrieval behaviors, information needs, user communities, human–computer interface design, and information visualization. IS also includes the production of information, from authors to printers, and the industries and consumers that keep them in business; government information collection and dissemination; business uses and maintenance of information. IS questions the premises on which information is collected, organized and disseminated—monitoring censorship and copyright, as well as the constraints and

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invisible information that may be lost by western, patriarchal or other ideological organizing schemes (whether conscious or unconsciously at work). IS includes understanding about reading, literacy, learning and the production and use of knowledge (e.g., philosophical approaches to knowledge as well as business approaches to knowledge management). IS applies across all fields, whether indexing the text produced by a field, or in formulating organizing schemes for data and knowledge in those areas. IS more recently includes understanding of the impact of information technologies and the Internet, particularly as these change the way we work and how this modifies the information environments in which we work. (Caroline Haythornthwaite [26])

Information Science is the study of the transformations and interactivities among data, information, knowledge and message objects, structures and processes, for the purpose of constructing systems to communicate culture as a regeneration of knowledge. Information science is the mutable and transitory discipline at the confluence of librarianship, documentation, media & communications, computation, and applied philosophy. Although the field emerged in the twentieth century with great force and seeming novelty, its growth as an intellectual discipline has been tentative and the enterprise shows much immaturity. (Ken Herold [27])

Information Science is the study of data, information, and knowledge and how it is used by individuals. Another term used to describe the study of information and its use is **'informatics.'** This term is particularly prevalent in the United States, and most frequently used in the context of the health and biomedical fields, e.g., medical informatics describes the study and use of information in clinical settings whereas bioinformatics describes the study and use of information in biomedical research settings (Hersh, 2002). (William Hersh [28])

Information science is a field studying the documentation of knowledge claims and their representation in primary, secondary and tertiary literatures and information services. Information Science is the study of knowledge dissemination, production and use. Books and documents are selected, represented, described, indexed and so on based on their assumed contribution to knowledge.

Information Science is a field that aims at providing better library, documentation, and information service to various groups of people. Historically, IS developed out of special librarianship and documentation. People in the field were originally subject specialists who worked to improve scientific and scholarly communication in their respective fields, or in general. In schools of IS, many attempts have been made to construe a theoretical framework for practical-oriented information activities. (Birger Hjorland [29])

Information science is the totality of the process of communication and understanding, both intra-and interpersonally. As such, it is a broad discipline, ranging from Shannonesque info theory to semiotics and memetics. Information Science is such a broad field that no single meaningful definition is possible unless we seek to limit it and define its other characteristics as something else. (Wallace Koehler[30])

Information science is the study of the phenomena surrounding information, including creation, acquisition, indexing, storing, retrieving, and disseminating information. (Donald Kraft [31])

Information science is the scientific study of information properties and processes (construction, communication and use). Information technology (the science of information techniques) is the scientific study of information products, services and systems (Le Coadic, 2004). (Yves François Le Coadic [32])

Information science is the science of the management and retrieval of information for action. (Jo Link-Pezet [33])

Information Science is the study of the nature of information, its attributes and forces governing a flow of information for the purpose of its optimal accessibility and utilization. Information Science concerns with both potential information[1] (recorded data) and psychophysical information (stored in a brain and processed in a consciousness). Information Science is concerned with receptivity of man in (organized) information environment and its impact to thought and behavior whereas Cognitive Science explores relation between the brain and thoughts. (Michal Lorenz [34])

Information Science is the study of information and the ways in which it is organized, stored and used, in the broadest sense. (Ia McIlwaine [35])

"The study of the mediating of human knowledge" would be sufficient though I'd prefer "knowledge in human societies" to possibly highlight the social character of the field. (Michel Menou [36])

Information Science is the study of information in its raw form. This includes: creating information based on data, retrieving information as basis for knowledge, and assessing the usefulness of information based on its organization and its meaning. (Haidar Moukdad [37])

Information Science studies information, focusing on the identification, behavior, characteristics, environmental context, use, management, and impact of information in its various forms (i.e., the data—information—knowledge—message continuum), and their instantiations (e.g., electronic data, electronic interactive, human & machine mediated, hardcopy forms, etc.), on tools and processes for their evaluation, control, transmission, and utilization, and on information futures. (Dennis Nicholson [38])

Information science is the rational and systematic study of the way information is created, stored, indexed, disseminated and used. It's not to do with knowledge, but with information—the formal recorded types of information in particular. Rationale: information science is to do with the ways human create and process information, so is primarily a social science. However, technological means are an important component, so some of information science falls within that ambit. (Charles Oppenheim [39])

Information Science is the scientific and interdisciplinary approach for the construction of concepts, principles, methods, theories and laws related to the information phenomena and their technological applications in the process of transfer information and its message (i.e., meaningful content) in a historical, cultural and social context. (Lena Vania Pinheiro [40])

[1]Potential information is knowledge taken down on material medium which can be communicated by means of dispensable devices. Data are specific kind of potential information, which circulate in machines (Cejpek, 1998).

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Information science is simply and plainly the science of the data and of the information, and consequently the domain of science charged of setting the transition between data and knowledge (Saracevic, 1999). (Maria Pinto [41])

Information science is an interdisciplinary field studying the sources, organization, communication, and uses of information. (Scott Seaman [42])

Information science is the science of how people become informed. It is the empirically derived theoretical base that underpins a variety of applications (e.g., knowledge management, librarianship, and documentation), and a variety of social and cultural expressions (e.g., information policy, and ethics). The process of becoming informed is both physiological and psychological, involving the communication of knowledge via messages. Knowledge is a human and social phenomenon, the deliberate product of the human mind. It can be recorded, which makes its communication more efficient, and facilitates its storage, manipulation, and retrieval. Knowledge is made up of raw elements, called data, and is carried in packages, called documents.

Information science embraces sub-disciplines, such as knowledge organization. It makes use of other disciplines such as psychology, physiology, sociology, anthropology, philosophy, communications, and the like.

Note, there is a difference between the science (i.e., 'information science'), and what we teach in schools (i.e., 'information studies'). The science is the area in which investigation furthers knowledge, while the more generic study incorporates applications. (Richard Smiraglia [43])

Information science is a name for one of the approaches to information and communication characterized by a background in specialized (scientific and technical) librarianship. The domain exists alongside information systems, informatics, communication studies and various other domains, with which there is surprisingly little linkage given that there is no real barrier separating them. (Paul Sturges [44])

Information science is the scientific investigation of information and its inherent nature, forms, and functions. (Joanne Twining [45])

Information science is the theoretical approach to understand and explore the information phenomenon, as the basis of human knowledge and social communication, as well as its tangible products. (Anna da Soledade Vieira [46])

Information science is what information scientists do (Roberts, 1976).[2] (Julian Warner [47])

Information science is the study of handling and mediating information, with relevance to both the subjective and objective domains of knowledge. (Irene Wormell [48])

Information Science is the study of appropriate human approaches to extracting information from data, and knowledge from information, as well as the study of approaches to composing message with the smallest number of clearest symbols to solve information explosion problem, and the study of approaches to impacting the production of information process with knowledge, and the production of data with appropriate amount of information. (Yishan Wu [49])

[2]See reference to this definition in Appendix B. Note that formal definitions, such as definition [47] are logically circular, and they do not help us to a better understanding of the meaning of the concept.

Last but not least, here are my definition and reflections on information science:

Definition. Based on the distinction between the subjective and the universal domains of date, information, and knowledge (Zins, 2006, in press-a), information science concentrates on the universal domain. It is focused on the meta-knowledge perspectives of universal knowledge. Information science is the study of the mediating perspectives of universal human knowledge (i.e., human knowledge in the universal domain). The mediating perspectives include cognitive, social, and technological aspects and conditions, which facilitate the dissemination of human knowledge from the originator to the user.

Cognitive sciences vs. information science. Unlike cognitive sciences and neurosciences, which focus on the subjective domain by exploring thinking and learning, information science explores cognitive aspects only in relation to facilitating the accessibility and usability of objective human knowledge. For example: while the information scientist explores how we access or search for new knowledge (what we, information scientists, call "user studies"), the cognitive scientist explores how we understand, remember, and utilize this knowledge.

Meta-knowledge of human knowledge. Information science is one of six knowledge fields that establish the meta-knowledge foundations of human knowledge. These are philosophy of knowledge (epistemology), philosophy of science, history 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 philosophical perspectives of science, and seeks to formulate a theory of science. History of science is the branch of history that explores the history of the various sciences. 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 is a branch of knowledge that is focused on exploring and formulating research methodologies in all branches of science. Information science is a branch of knowledge that explores the mediating perspectives of human knowledge. (Chaim Zins [50])

Conceptual Approaches

Anthropological document. Fifty scholars (including myself) shared their thoughts and formulated 50 definitions of information science. This collection of definitions is an invaluable "anthropological document" that documents the conceptions of information science, as they are understood by leading scholars in the information science academic community.

Delimitations. Words can be misleading. Definitions are theory laden. They can best be analyzed and evaluated in the context of the relevant theory. For this very reason, the panel members were repeatedly asked to make sure that their

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definitions of information science are consistent with their definitions of data, information, and knowledge (see Zins, in press-a). Many of the 50 citations reflect systematic and comprehensive thinking and are based on relatively solid theoretical and philosophical foundations. However, a few are incomplete, inconsistent, and logically faulty. Therefore, the study is focused on mapping the theoretical issues that we face while formulating coherent conceptions of information science, and the conceptual approaches to resolve them, rather than on evaluating the accuracy, adequacy, and coherency of the panel's diversified definitions.

Key issues. Words can be misleading. Therefore, to resolve the chaotic condition of diversified meanings and interpretations that emerge from the 50 citations we need to explore, identify, and formulate the constitutive competing conceptions that lie beneath the phrasing. In the course of the study, the panel members critically confronted a variety of issues while formulating their definitions (see Appendix B). Based on the panel discussions, conceptions of information science differ mainly on three key issues: phenomena, domain, and scope: What are the explored phenomena? What is the domain of the field? What is the scope of the exploration?

Explored phenomena. What are the explored phenomena of information science? The definitions provide four different foci: data (e.g., citation [12]) versus information (e.g., citation [26]) versus knowledge (e.g., citation [6], and [29]) versus message (e.g., citation [10]). First, agreement has to be reached on the explored phenomena: data versus information versus knowledge versus message (D-I-K-M). Nevertheless, analysis of the panel's definitions of D-I-K-M (see Zins, in press-a) made it clear that the wording can be deceptive. Panel members often misused the terminology. Therefore, I adopt Begthol's definition (see citation [5]) as an ad hoc position that IS explores D-I-K-M phenomena, without differentiating, however defined and in whatever relation to each other. The reader is free to refine this decision.

Domain. What is the domain of the field? Three different foci emerge: culture versus technology versus hi-tech. Hi-tech (i.e., computer-based technology) is a subcategory of technology (i.e., the physical tools developed by humans to meet their needs), and technology is a subcategory of culture (i.e., overall human activity and creativity in the social context). Does IS explore the D-I-K-M phenomena in the cultural (i.e., social) domain (e.g., information policy, ethics, and legal aspects), as it is reflected, for example, in citation [36]? Does it explore D-I-K-M phenomena in the technological domain (i.e., focusing on D-I-K-M technologies, such as paper technologies and computer technologies)? Or does it focus on hi-tech (e.g., computer-based information technologies), as it is reflected, for example, in citation [2]?

In fact, the panel endorses only the cultural and the hi-tech approaches, whereas the technological approach is rather theoretical. This observation is also supported by Buckland's definition (citation [7]). In a recent correspondence Buckland wrote:

> If we were now starting your Delphi study I think that I should now make more of a distinction between the Information Science that is, or overlaps with, Library and Information Science and the formal, quantitative Information Science associated with cybernetics and general systems theory. (Michael Buckland [51])

Nearly all the panel members follow the cultural approach. Obviously, it can be characterized as representing the mainstream of the field. To summarize, theoretically there are three approaches regarding the domain of the field (i.e., culture vs. technology vs. hi-tech). However, the real dilemma is between the cultural and the hi-tech approaches, while the cultural approach seems to represent the mainstream of the field.

Scope. The third issue is determining the scope of the exploration. What is the scope of the exploration? Two approaches emerged: mediating aspects versus all the aspects of the explored phenomena. Does IS explore the mediating aspects of D-I-K-M phenomena, namely those aspects involved in facilitating the connection between the D-I-K-M originators and users, as it is claimed, for example, in citations [9], [36], and [48]? Or does it explore all the aspects of D-I-K-M, as it is claimed, for example, in citations [12], and [26]?

Six conceptions. Resolving the three issues is crucial. It underlies six generic conceptions, or models, of Information Science (see Figure 1). The six models of Information Science are:

- The Hi-Tech Model. Information science is the study of the mediating aspects of D-I-K-M phenomena as they are implemented in the hi-tech domain. This model is exemplified in citations [2] and [19].
- The Technology Model. Information science is the study of the mediating aspects of D-I-K-M phenomena as they are implemented in all types of technologies. This model seems to be reflected in citation [18].
- The Culture Model. Information science is the study of the mediating aspects of D-I-K-M phenomena as they are implemented in the cultural domain. This model is exemplified in citations [1], [6], [7], [8], [14], [15], [21], [25], [27], [29], [34], [35], [36], [40], [43], [48], [49], and [50].
- The Human World Model. Information science is the study of all the aspects of D-I-K-M phenomena as they are implemented in the human realm. This model is exemplified in citations [12],[3] [13],[3] [20], [26], and [30].
- The Living World Model. Information science is the study of all the aspects of D-I-K-M phenomena as they are implemented in the living world, human and non-human. This model is exemplified in citations [12],[3] [13],[3] [24][3]

[3]Note that citations [12], [13], and [24] exemplify two models because their phrasings are too general.

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Characteristics: Scope	Domain	Explored Phenomena: Data	Information	Knowledge	Message
Mediating	Model (1) **Hi-Tech**	(Focusing on the mediating aspects of D-I-K-M as they are implemented in computer-based technologies)			
Mediating	Model (2) **Technology**	(Focusing on the mediating aspects of D-I-K-M as they are implemented in all types of technologies)			
Mediating	Model (3) **Culture/Society**	(Focusing on the mediating aspects of D-I-K-M as they are implemented in human societies)			
Inclusive (all aspects)	Model (4) **Human World**	(Focusing on all aspects of D-I-K-M as they are implemented in the human realm)			
Inclusive (all aspects)	Model (5) **Living World**	(Focusing on all aspects of D-I-K-M as they are implemented in the living world)			
Inclusive (all aspects)	Model (6) **Living & Physical Worlds**	(Focusing on all aspects of D-I-K-M as they are implemented in all types of biological organisms, human and non-human, and all types of physical objects)			

FIG. 1. A map of conceptions of information science.

- The Living & Physical Worlds Model. Information science is the study of all the aspects of D-I-K-M phenomena as they are implemented in all types of biological organisms, human and nonhuman, and all types of physical objects. This conception is reflected in citation [24].[3]

Mediating models versus inclusive models. The six conceptions are divided into two major groups, the mediating conceptions versus the inclusive conceptions. The first group, the mediating conceptions, is characterized by a focus on the mediating perspectives of the D-I-K-M phenomena. It includes the first three models, which differ in their foci: hi-tech versus technology versus culture (i.e., society). The second group, the inclusive conceptions, is characterized by a focus on all aspects of the D-I-K-M phenomena. It includes three generic conceptions, which differ in their foci: humans versus living organisms versus living organisms and physical objects.

The mediating conceptions and the inclusive conceptions differ by their underling rationales. The mediating conceptions are based on the rationale that the uniqueness of information science, as opposed to any other field, is focused on exploring the mediating aspects of human knowledge (or D, I, or M, mutatis mutandis) rather than on exploring the human knowledge (or D, I, or M, mutatis mutandis) phenomena per se. By focusing on the mediating aspects information science differs, for example, from cognitive sciences (i.e., the study of the cognitive aspects), epistemology (i.e., the study of the philosophical perspectives), sociology of knowledge (i.e., the study of the sociological perspectives), and education (i.e., the study of the dissemination of knowledge).

The inclusive conceptions, on the other hand, are based on the rationale that information science is a generic (or an umbrella) field that embraces all the other fields that explores the D-I-K-M phenomena, mutatis mutandis. Note that information science cannot explore "all the aspects" without being a generic name. Consequently, in the inclusive models, cognitive sciences, epistemology, philosophy of science, sociology of knowledge, education, linguistics, semiotics, logic and the like are subfields of information science. Accordingly, all these fields are information sciences.

To summarize, according to the three mediating conceptions information science is one field next to other fields, which explore the various perspectives of the D-I-K-M phenomena, whereas according to the three inclusive conceptions information science is a name for a generic field that comprises all the other fields that explore the various perspectives of the D-I-K-M phenomena.

Six information sciences. The six models imply six different bodies of knowledge. Consequently, they establish six different fields of knowledge; all carry the same name, *information science*. No wonder that scholars, practitioners, and students are confused. In the analysis of the panel members' responses, the hi-tech model, the culture model, the human world model, and the living world model emerged as more significant. The vast majority of the panel responses—as well as myself—represent the culture model. Although the study is qualitative, it seems that the culture model represents the mainstream of contemporary information science.

A Concluding Remark

This study maps the major issues on the agenda of scholars engaged in exploring and substantiating the foundations of information science. Conceptual approaches were identified and formulated for defining the concept of information science. This might help the reader to a better understanding of the issues and the considerations involved in establishing a systematic and comprehensive conception; however, by no means does it replace the personal quest to ground one's positions on solid theoretical foundations.

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Appendix A

The Panel

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Technical University, France; **Dr. Jo Link-Pezet**, Urfist, and University of Social Sciences, France; **Mr. Michal Lorenz**, Masaryk University in Brno, Czech Republic; **Prof. Ia McIlwaine**, University College London, UK; **Prof. Michel J. Menou**, Knowledge and ICT management consultant, France; **Prof. Haidar Moukdad**, Dalhousie University, Halifax, Nova Scotia, Canada; **Mr. Dennis Nicholson**, Strathclyde University, UK; **Prof. Charles Oppenheim**, Loughborough University, UK; **Prof. Lena Vania Pinheiro**, Brazilian Institute for Information in Science and Technology, Brazil; **Prof. Maria Pinto**, University of Granada, Spain; **Prof. Roberto Poli**, University of Trento, Italy; **Prof. Ronald Rousseau**, KHBO, and University of Antwerp, Belgium; **Dr. Silvia Schenkolewski-Kroll**, Bar Ilan University, Israel; **Mr. Scott Seaman***, University of Colorado, Boulder, CO, USA; **Prof. Richard Smiraglia**, Long Island University, Brookville, NY, USA; **Prof. Paul Sturges**, Loughborough University, UK; **Prof. Carol Tenopir**, University of Tennessee, Knoxville, TN, USA; **Dr. Joanne Twining**, Intertwining.org, a virtual information consultancy, USA; **Prof. Anna da Soledade Vieira**, Federal University of Minas Gerais, Brazil; **Dr. Julian Warner**, Queen's University of Belfast, UK; **Prof. Irene Wormell**, Swedish School of Library and Information Science, Borås, Sweden; **Prof. Yishan Wu**, Institute of Scientific and Technical Information of China (ISTIC), China.

*An observer (i.e., those panel members who did not strictly meet the criteria for the panel selection and terms of participation.)

Appendix B

Excerpts From the Three Questionnaires on Information Science

Knowledge Map of Information Science:
Issues, Principles, Implications
(First Round)
December 15, 2003

. . .

4: Information Science

Information science: Definition.

Question 4.1 What is "information science"? (Please formulate your definition. Please refer to relevant theoretical background. Thanks.)
Answer 4.1
Information science is . . .

The researcher's conceptions. At this point, I present my conceptions to the panel. If you would like to have a detailed paper, please contact me.

Definition. Following the distinction between the subjective and the objective domains, information science concentrates on the latter. It is focused on the meta-knowledge aspects of objective knowledge. **Information science is the study of the mediating and technological aspects of human knowledge** (in the objective domain). "Technology" is used here in its broadest sense, namely any physical tool created by humans. In the context of information science, it refers to papyrus and paper, as well as print and computers.

Cognitive sciences vs. information science. Unlike cognitive sciences and neurosciences, which focus on the subjective domain by exploring thinking and learning, information science explores cognitive aspects only in relation to facilitating the usability and accessibility of objective human knowledge. For example: while the information scientist explores how we access or search for new knowledge (what we, information scientists, call "user studies"), the cognitive scientist explores how we understand, remember, and utilize this knowledge.

Meta-knowledge of human knowledge. Information science is one of knowledge fields that establish the meta-knowledge foundations of human knowledge: epistemology, philosophy of science, sociology of knowledge (. . .). 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.

Question 4.2
Do you accept my conceptions of IS? If you have comments, observations, or critical reflections, please share them with the panel. Thanks.
Answer 4.2

Graphic representation. The following schematic map in Table B1 presents the place of information science in a map of human knowledge, according to my conception.

Graphic representation

TABLE B1. A map of human knowledge.

Foundation (meta-knowledge)	(e.g., Epistemology Philosophy of Science, Sociology of Knowledge, **Information Science**)
Natural & Life Sciences	(e.g., Biology)
Social Sciences	(e.g., Sociology)
Humanities	(e.g., Philosophy)
Technologies	(e.g., Computer Science)

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TABLE B2. A map of human knowledge.

Foundation
(meta-knowledge)
Natural and Life Sciences
Social Sciences
Humanities
Technologies

Question 4.3
Place Information Science in a schematic map of human knowledge. (Use the following map or create *your own* map by changing the number and names of the major categories. Please explain the rationale.
Answer 4.3
Rationale:

(See Table B2.)

Knowledge Science. I suggest changing the name of the field from "Information Science" to "Knowledge Science."

Question 4.4
Do you agree to change the name of the field from "Information Science" to "Knowledge Science"? (Please explain and elaborate.)
Answer 4.4

Question 4.5
If you have a better name, here is the place to convince the panel. Thanks.
Answer 4.6

Question 4.6
If you have any comment, suggestion, or critical reflection, please share it with the panel.
Answer 4.6

. . .

Knowledge Map of Information Science: Issues, Principles, Implications (Second Round)
April 15, 2004

. . .

3: Conceptions of Information Science

Difficulties. While analyzing more than fifty definitions I have identified several conceptions of Information Science. The first definition demonstrates the difficulties I faced while analyzing the panel's definitions. At first glance, it seems to stress the notion of access systems. The following paragraphs broaden the meaning:

► *"**Information science is that field of inquiry that deals with information systems,** so that it can provide **access** to information in an effective and/or efficient manner. This information is relevant to the diverse cognitive needs of information seekers, particularly those needs considered to be of a 'high-order.'*

It provides access to knowledge stores. It studies information as a resource that can be enriched through a variety of value-added processes; easy and timely access, whether through physical, electronic or intellectual means; the use of intellectual technologies such as knowledge organization, abstracting, and indexing; insurance of data accuracy and system reliability; ability to browse holdings and uncover related materials in information systems or networks; Ability to provide precise or comprehensive, current and valid information in forms that are useful for end-users; ability to do comprehensive inventories of information needs and to integrate the diverse forms of information media; and the ability to save time and money for information seekers in their search for relevant materials. This characterization draws heavily on the work of Robert Taylor, Value-Added Processes in Information Systems. It studies information environments and/or information users and develops systems, products, services and policies to meet their information requirements in whatever kind of organization." **[1s]**

The panel's definitions. Let us review selected definitions. Please be aware, the wording can be misleading. The grouping is designed to call your attention to some common characteristics. Note that the groups are not exclusive. In order to facilitate a quick review I have **marked** key words.

Group 1: Inclusive definitions—the study of all the aspects of . . . (data, information, and/or knowledge)

► *"**Information science is the study of information in all its manifestations.***

Although attention is directed traditionally to information storage and retrieval—including library systems, classification schemes, indexing and abstracting, catalogs, as well as search engines, concept mapping, studies of relevance and retrieval—this expands to include user search and retrieval behaviors, information needs, user communities, human-computer interface design, and information visualization. IS also includes the production of information, from authors to printers, and the industries and consumers that keep them in business; government information collection and dissemination; business uses and maintenance of information. IS questions the premises on which information is collected, organized and disseminated—monitoring censorship and copyright, as well as the constraints and invisible information that may be lost by western, patriarchal or other ideological organizing schemes (whether conscious or unconsciously at work). IS includes understanding about reading, literacy, learning and the production and use of knowledge (e.g., philosophical approaches to knowledge as well as business approaches to knowledge management). IS applies across all fields, whether indexing the text produced by a field, or in formulating organizing schemes for data and knowledge in those areas. IS more recently includes understanding of the impact of information technologies and the Internet, particularly as these change the way we work and how this modifies the information environments in which we work." **[2s]**

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Researcher's comment: The definition is too broad. It includes other sciences that explore manifestations of information; for example: library science, cognitive sciences, neurosciences, education, cultural studies, sociology of knowledge, epistemology (philosophy of knowledge), philosophy of science, etc.

► *"Information science is the study and practical management of* ***recorded information*** *(including data recorded as information) through* ***all*** *points of the information life cycle. (What distinguishes this definition from preceding remarks is the emphasis on the word "****all****" - many people relate in theory or practice to parts of the life cycle)."* **[3p]**

Researcher's comment: Zooming into recorded information limits the scope of IS. However, the emphasis of "all" makes it too broad.

► *"Information science is the study* ***of the interaction between humans and information*** *and* ***all*** *the mechanisms and elements of context that play a role in this interaction."* **[4s]**

Researcher's comments: The definition is too broad. It is applicable to IS as well as to cognitive sciences, Sociology of knowledge, etc.

► *"Information science is an interdisciplinary field encompassing* ***all*** *aspects of* ***data*** *from* ***data*** *generation via measurement and observation, through data capture, analysis, representation, organization, evaluation, storage, transformation, presentation, protection, and retention."* **[5s]**

Researcher's comments: The definition shifts the attention from information to data.

Group 2: Specified definitions—the study of specified aspects of . . . (data, information, and/or knowledge)

► *"Information science is the field formerly known as* ***Documentation*** *is now commonly referred to as "Information Science."*

My definition would be that it is, broadly, concerned with the ***creation***, ***dissemination***, *and* ***utilization of knowledge****." Within that broad scope there tend to be two subareas: a wide-ranging concern with* ***human and social aspects****: information related behavior, organizational and social concerns; and a technical / engineering concern with the design and evaluation of* ***information systems****."* **[6s]**

Researcher's comments: (1) According to your definition, "knowledge" and "information" are synonyms. If not, please clarify, or rephrase your definition. (2) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, neurosciences, sociology of knowledge, etc.) that explore the **creation** of knowledge. (3) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, education, medicine, etc.) that explore the **utilization** of knowledge. Thanks.

► *"Information science is an interdisciplinary field concerned with the* ***theoretical*** *and* ***practical*** *concepts, as well as the technologies, 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."* **[7s]**

Researcher's comments: (1) According to your definition, "knowledge" and "information" are synonyms. If not, please clarify, or rephrase your definition. (2) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, neurosciences, sociology of knowledge, etc.) that explore the **creation** of knowledge. (3) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, education, medicine, etc.) that explore the ***utilization*** of knowledge. Thanks.

► *"Information science is the study of the phenomena surrounding information, including creation, acquisition, indexing, storing, retrieving, and disseminating information."* **[8s]**

Researcher's comments: (1) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, neurosciences, sociology of knowledge, etc.) that explore the **creation** of knowledge. Thanks.

► *"Information science is the study of production, organization, control, and use of information in any support and going thought channel."* **[9s]**

Researcher's comments: (1) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, neurosciences, sociology of knowledge, etc.) that explore the ***production*** of knowledge. (2) Please clarify the distinction between IS and other sciences (e.g., cognitive sciences, education, medicine, etc.) that explore the ***use*** of knowledge. Thanks.

► *"Information science is the study of handling and* ***mediating*** *information, with relevance to both the* ***subjective*** *and* ***objective*** *domains of* ***knowledge****. It bridges the two worlds!"* **[10s]**

Researcher's comments: According to your definition, "knowledge" and "information" are synonyms. If not, please clarify, or rephrase your definition. Thanks.

► *"Information science is the study of the* ***mediating*** *and* ***technological*** *aspects of* ***information*** *accumulation, publication, communication and interpretation."* **[11s]**

Group 3: The study of mediating/documentation of knowledge

► *"The study of the* ***mediating*** *of* ***human knowledge****" would be sufficient though I'd prefer "****knowledge*** *in* ***human societies****" to possibly highlight the* ***social*** *character of the field."* **[12s]**

► *"Information science is a field studying the* ***documentation*** *of* ***knowledge*** *claims and their representation in primary, secondary and tertiary literatures and information services."* **[13s]**

Group 4: The study of systems (data, information, and/or knowledge)

► *"Information science attempts to study and establish the theories, laws and principles that govern the analysis, design and evaluation of* ***technologically augmented Data, Information and Knowledge (ADIK) systems****."* **[14s]**

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► *"Information science is the science of **information society** (or of **information systems**). It studies the information and its four basic processes - information generation, communication, information storage and information use - in order to optimize them (all these processes being time and resources dependent)."* **[15s]**

Researcher's comment: In this definition, the two concepts "information society" and "information systems" are equivalent.

► *"Information Science is concerned with design and use of **information systems** for **mediation** of knowledge."* **[16s]**

► *"Information science is the study of **systems phenomena** with a focus on **information subsystem** processes and behaviors, and the chaotic aspects of all this."* **[17s]**

Group 5: The study of communication

► *"Information science is the totality of the **process of communication** and understanding, both intra- and inter-personally. As such, it is a broad discipline, ranging from Shannonesque info theory to semiotics and memetics."* **[18s]**

► *"Information science is a science dealing with the **phenomenon of messages** as part of the **phenomenon of communication**, i.e., including the 'meaning offer,' the process of selection ('information') and the process of interpretation (understanding)."* **[19s]**

Group 6: Information Science as Part of Library Science

► *"Information science is a self-serving attempt to ennoble what used to be called 'library science'."* **[20s]**

Researcher's comment: Please define LS. Thanks. Library Science is . . .

► *"Information science is a subdiscipline of Metalibrarianship . . . IS is concerned with the scientific processing of information bearing artifacts, which includes manipulation of the objects themselves, and manipulation of the objects in relation to the user . . ."* **[21s]**

Group 7: Contradicting views—information vs. technology

The following definitions reflect Contradicting views regarding the technology:

► *"Information science is composed of theoretical and applied efforts to define information, how it may be processed with **computers** and **affiliated technologies** (= **information systems**), and how such information and systems may interact with specific human practices and studies, such as business, culture, philosophy, etc."* **[22ph]**

► *"Information science is the study of how information is used, acquired, organized, and evaluated by humans. Defined this way, it is essentially synonymous with "informatics" as it used in the context of health/biomedical informatics in the United States. A key point is that it focuses on **information as opposed to technology**."* **[23s]**

► *"Information science is a **mathematical discipline** that studies **technological ways of conveying information**."* **[24s]**

Group 8: Formal definition

► *"Information science is what information scientists do (Roberts, 1976)."* **[25s]**

Researcher's comment: This formal definition is logically circular. In order to avoid the logical circularity you need to formulate substantive characteristics of "information scientists" without using the term "information science." It seems simpler to formulate a substantive definition, rather than a formal one.

Question 3.1
If you have any comment regarding one of the definitions, the researcher's comments, or the order of the definitions, please share them with the panel.
Answer 3.1

Question 3.2
If you wish to revise your definition, please do so.
Answer 3.2
Information Science is . . .

4: Systematic Conceptions of Information Science

Preliminary remarks. Many of you devoted time and intellectual effort to discuss these issues. I have found that this philosophical deliberation is fascinating, and contributes to the theoretical foundations of Information Science. I will present it in future publications. However, while analyzing the argumentations it became evident that for the purpose of the questionnaire we need to neutralize disagreements rooted in different theoretical traditions and originating in ascribing different meanings to key concepts. Therefore, I will use *ad-hoc* stipulated definitions to define the key concepts.

Key issues. Generally, the panel disagrees on the essence and the foci of the explored phenomena. In order to formulate a comprehensive conception of Information Science we need to address five key issues. The first issue is the most fundamental. It defines the explored phenomena. The other four issues refine the essential characteristics:

(1) **The explored phenomena:** data vs. information vs. knowledge vs. message.
(2) **The domain:** collective (or objective) vs. subjective vs. both domains.

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(3) **The approach:** inclusive (all aspects) vs. mediating aspects.
(4) **Context:** culture/society vs. technology vs. hi-tech.
(5) **User studies.** Are user studies parts of Information Science?

The explored phenomena. What are the explored phenomena of IS? The panel provides five generic answers: **data** (e.g., cit. **5s**), **information** (e.g., cit. **2s**), **knowledge** (e.g., cit. **12s**, **13s**), message (e.g., cit. **19s**), and **systems** (s e.g., cit. **14s**, **16s**). Since **Systems** are always systems of **data**, **information**, or **knowledge**, we first have to discuss these phenomena. We are left with **data**, **information**, **knowledge**, and **message**.

***Ad-hoc* definitions.** As noted above, in order to neutralize disagreements originating in ascribing different meanings to "data," "information," "knowledge," and "message" let us use *ad-hoc* stipulated definitions. For the purposes of this questionnaire:

> *"**Data** (the plural of *datum*)" are sets of symbols that represent **empirical perceptions** (e.g., an image of a chair, a voice of a child while pronouncing the word "chair").
>
> *"**Information**" is a set of symbols that represent **empirical knowledge** (e.g., "the panel is composed of 54 members.").
>
> *"**Knowledge**" is a set of symbols that represent thoughts, which the individual **justifiably believes** that they are **true** (e.g., "2 + 2 = 4", "Cogito ergo sum", "$E = MC^2$").
>
> *"**Message**" is a set of symbols that represent any **meaningful content** (e.g., "I have 10 fingers," "I have 15 fingers," an image of a chair, the phrase "The White House," the image of the White House, a recording of Beethoven's Piano Concerto n. 5.)

According to these *ad-hoc* definitions, ***datum*** is the smallest unit of meaningful content, and ***message*** is the broadest one. Note that the four concepts are in the collective domain.

Question 4.1
Based on the *ad-hoc* definitions, please redefine the explored phenomena of IS? (Please explain the rationale. Thanks)
Answer 4.1
Information Science is the study of . . .

The domain. Following the distinction we made between the **collective** (or objective) domain and the **subjective** domain, the question is whether Information Science is the study of data, information, knowledge, or message, as they exist in the **collective** domain (e.g., cit. **24s**), in the **subjective** domain, or in **both** domains (e.g., cit. **10s**)?

Question 4.2
Are data, information, knowledge, or message studied as they exist in the collective domain, in the subjective domain, or in both domains? (Please select and explain)
Answer 4.2

The approach. The responses reflect two approaches regarding the explored aspects of the studied phenomena. At least four panel members hold the inclusive approach, namely they claim that Information Science is the study of all the aspect of the explored phenomena (e.g., cit. **2s**, **3p**, **4s**, **5s**). Others claim that Information Science is focused on the **mediating** aspects (e.g., cit. **10s**, **11s**, **12s**, **16s**)?

Question 4.3
Does Information Science explore all the aspects of the phenomena, or does it explore only the mediating aspects? (Please select and explain)
Answer 4.3

The context. The context of the exploration is significant for determining the scope of the field. If, for example, one defines Information Science as the study of *technologically augmented Data, Information and Knowledge (ADIK) systems* (cit. **14s**), s/he needs to specify the context. Within the framework of culture/society, ADIK can be a library, while in the context of technology, it can be a printed book, and in the context of hi-tech, it can be a digital library. Note that "**culture**" relates to society's ways of facing reality. "**Technology**" relates to the various tools created by humans. Thus, *technology* is a sub-category of *culture*, and *hi-tech*, is a sub-category of *technology*.

Question 4.4
What is the context of the exploration? Is it within the context of culture/society, technology (in general), or hi-tech? (Please select and explain)
Answer 4.4

User studies. Are user studies parts of Information Science? Following cit. **1s**, **2s**, **7s**, **21s** user studies are parts of IS, while based on cit. **24s** they are not.

Question 4.5
Are user studies parts of Information Science?
Answer 4.5

A systematic conception. Evidently, a systematic conception of Information Science should adequately specify the explored phenomena of the field. This means that in the process of defining the concept we are required to relate to each one of these five key issues.

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Question 4.6
Please recheck your definition of "Information Science." If it does not correlate with your answers to the five key issues, please revise your definition. Thanks.
Answer 4.6
Information Science is . . .

Question 4.7
A. Please recheck your list of IS key concepts (question 2.1.A). If it is not coherent with your revised definition of IS, please revise the list. Thanks.

B. Please recheck your list of IS major subfields (question 2.1.B). If it is not coherent with your revised definition of IS, please revise the list. Thanks.
Answer 4.7

Question 4.8
If you have any comment regarding the analysis and the argumentation, please share it with the panel. Thanks.
Answer 4.8

5: A Map of Conceptions of Information Science

At this point, we are in a position to develop a model, which maps the different conceptions of Information Science, and assists us in establishing the mainstream of the field. Please note that this is a preliminary presentation of the model. The model is incomplete. We still need to refine and evaluate it. (See Figure B1.)

Question 5.1
Please place your revised conception of IS in the model. Thanks.
Answer 5.1

Question 5.2
If you have any comment, suggestion, or observation regarding the model, or an alternative model, please share them with the panel. Thanks.
Answer 5.2

Knowledge Map of Information Science: Issues, Principles, Implications (Third Round)
October 8, 2004
. . .
3: Conceptions of Information Science

Clarifying the disagreements. At this point, we can conclude that the panel disagrees on the conception of IS. It is therefore more fruitful to identify and sharpen the various positions regarding the key issues rather than to seek a deceptive consensus.

Three axes. The conceptions of IS differ mainly on 3 axes: **Phenomena**, **Domain**, **Scope**:

(1) The explored **Phenomena**: **data** vs. **information** vs. **knowledge** vs. **message**
(2) The **Domain**: **hi-tech** vs. **technology** vs. **culture**
(3) The **Scope**: **mediating aspects** vs. **all the aspects** of the explored phenomena.

				Explored Phenomena: (A) Data	(B) Information	(C) Knowledge	(D) Message
Characteristics: Mediating	Collective Domain	(1) **Hi-Tech**			Ex. cit. **24s**		
		(2) **Technology**					
		(3) **Culture/Society**			Ex. cit. **3p**		
	Collective & Subjective Domains	(4) **Hi-Tech**	+**User Studies**				
		(5) **Technology**	+**User Studies**				
		(6) **Culture/ Society**	+**User Studies**		Ex. cit. **11s**	Ex. cit. **12s**	
Inclusive	**All aspects of subjective & collective Domains**	(7)		Ex. cit. **5s**	Ex. cit. **2s, 4s**		

FIG. B1. A map of conceptions of information science.

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Ad-hoc working definitions. Some of the disagreements within the panel are caused by the terminology. In order to facilitate meaningful discussions let us use ad-hoc **working** definitions. Please follow these ad-hoc **working** definitions for answering the questions. However, if you cannot use the ad-hoc working definitions for answering the questions, please redefine the relevant concepts, or refer me to your definitions in rounds 1 & 2 so that I will be able to understand your position adequately. Thanks.

The explored phenomena. There are four options: data, information, knowledge, and message. For the purpose of the study let us use the following ad-hoc definitions:

"**Data**" are sets of symbols that represent **empirical perceptions** (e.g., an image of a chair, the voice of a child pronouncing the word "chair"). "**Information**" is a set of symbols that represent **empirical knowledge** (e.g., "The panel is composed of 55 members."). "**Knowledge**" is a set of symbols that represent thoughts, which the individual **justifiably believes** to be **true** (e.g., "2 + 2 = 4", "Cogito ergo sum", "$E = MC^2$"). "**Message**" is a set of symbols that represent any **meaningful content** (e.g., "I have 10 fingers," "I have 15 fingers," an image of a chair, the phrase "The White House," the image of the White House, a recording of Beethoven's Piano Concerto n. 5, the musical notes of Beethoven's Piano Concerto n. 5). 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. Figure B1 presents the logical relations among D-I-K-M.

Understanding and Wisdom. Several participants suggested adding "understanding" and "wisdom" to the equation but they did not elaborate. I hardly see how these concepts contribute to the conception of IS. Note that "meaningful content" embodies understanding, and "wisdom" (or rather "reason") is explored by *Philosophy*.

Researcher's reflections: meaningful contents. I would like to share with the panel my reflections on the explored phenomena. Ten years ago when I first thought about this study it was clear to me that the explored phenomena are information. When I submitted the first round I was convinced that IS explores knowledge, and we should redefine "Information Science" as "Knowledge Science". Following the panel discussions in the first and the second rounds, I went one step forward towards the message phenomena. A few days ago I received the last issue of the *Journal of the American Society for **Information** Science* 55(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). So, Information scientists do explore messages (i.e., meaningful contents). It seems that *Information Science* has actually turned into *Message Science*, or rather *Content Science*. (See Figure B2.)

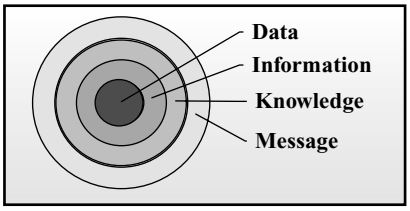

FIG. B2. The explored phenomena.

Question 3.1 What are the explored phenomena (data vs. information vs. knowledge vs. message)? Please use the ad-hoc definitions or define the terminology. Thanks.
Answer 3.1

Question 3.2 If you have critical reflections, please let me know. Thanks.
Answer 3.2

The domain. There are three options regarding the domain: hi-tech vs. technology vs. culture. For the purpose of this study let us use the following ad-hoc definitions: "**Culture**" is the society's various ways to face reality. "**Technology**" is the various tools created by humans. "**Hi-tech**" is computer/electronics based technology. Therefore, *hi-tech* is a sub-category of *technology*, and *technology* is a sub-category of *culture*.

Figure B3 presents the logical relations among the HT-T-C domains.

Question 3.3 What is the domain (hi-tech vs. technology vs. culture)? Please use the ad-hoc definitions or define the terminology. Thanks.
Answer 3.3

The scope. The third axis is the scope. There are two options: The **mediating** aspects vs. all the aspects of the explored phenomena (inclusive). The *mediating* aspects are all the aspects relevant to facilitating D, I, K, or M (including user studies). The *inclusive* scope includes mediating and non-mediating aspects of D, I, K, or M, such as astronomical aspects, biological aspects, and chemical aspects.

Figure B4 presents the logical relations among the M-I scopes.

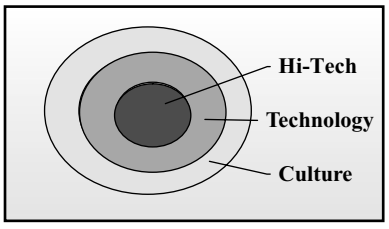

FIG. B3. The domain.

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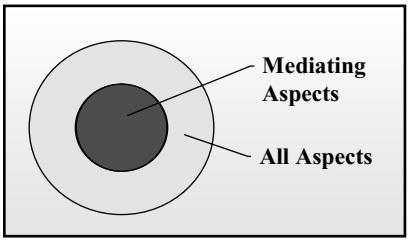

FIG. B4. The scope of information science.

Question 3.4 What is the scope (mediating vs. all aspects (inclusive))? Please use the ad-hoc definitions or define the terminology. Thanks.
Answer 3.4

Question 3.5 If you want to revise your conception of IS, please do it here. Thanks.
Answer 3.5

. . .
7: Selected Responses
. . .

► **Conception of Information Sciences.** *"Often, a distinction between information science and information technology might be useful. Scientific schemes relate to the study of phenomena, systems, processes, in the quest for basic laws and principles, while information technology would be concerned with facilitation of communication processes, especially for durable messages. The notion that information science evolved strictly out of documentation is a common misconception; information science's roots can be traced to a broad set of behavioral/communication sciences (cybernetics, systems theory, etc.) that evolved following World War II (Harmon, 1971).*

Question 7.1 If you have critical reflections on the responses, please let me know. Thanks.
Answer 7.1˚

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