Classification Schemes of Information Science: Twenty-Eight Scholars Map the Field

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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 a group of four articles, which resulted from a Critical Delphi study conducted in 2003–2005 (Zins, 2007a, 2007b, 2007c). 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. This particular article documents 28 classification schemes of Information Science that were compiled by leading scholars in the academic community. This unique collection of 28 classification schemes portrays and documents the profile of contemporary Information Science at the beginning of the 21st century.

Context

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 part of a group of four articles, which resulted from a 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, 2007b), as well as the major conceptions of Information Science (Zins, 2007a). It portrays the profile of contemporary Information Science by documenting 28 classification schemes compiled by leading scholars over the course of the study, which are presented here; and culminates in developing a scientifically based and theoretically grounded knowledge map (Zins, 2007c).

Formulating a knowledge map—which is equivalent here to a subject classification scheme—means to set the boundaries of the field and define its main parts. This article is

focused on exploring how leading scholars and practitioners in the academic milieu map the field. This exploration is an important step on the road to understanding the essence of contemporary information science and to ground the mapping of the field on empirical data.

Knowledge Mapping

Knowledge mapping plays an essential role in the construction, learning, and dissemination of knowledge (Zins, 2004). How do information scientists structure the field of Information Science? The literature provides thousands of knowledge maps; not all of them are comprehensive and systematic. In fact, most of them are partial, incomplete, and inconsistent. Knowledge maps of the field can be found in library classification schemes (e.g., Library of Congress Classification [LCC], Dewey Decimal Classification [DDC], and Universal Decimal Classification [UDC]), classification schemes in bibliographic resources, information services and databases (e.g., Information Science Abstract [ISA] and Library and Information Science Abstract [LISA]), thesauri (e.g., *ASIS Thesaurus of Information Science and Librarianship*; Milstead, 1998), conferences' programs (e.g., American Society for Information Science and Technology [ASIST] Annual Meeting), course syllabi, introductory texts, and encyclopedia entries. Nearly every book on information science explicitly or implicitly presents a knowledge map of the relevant body of knowledge in its table of contents.

Still the structuring has to be systematic. Formulating a systematic knowledge map should be based on a systematic conception of the field. Formulating a systematic conception of Information Science should be grounded on systematic conceptions of the constitutive concepts data, information, and knowledge (see Zins, 2007b). This article documents 28 classification schemes that portray the diversified aspects of the field. All of them are based on reflective thinking.

Methodology

The scientific methodology is 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 is composed of 57 participants from 16 countries. The panel is unique and exceptional; it is comprised of leading scholars who represent 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 contained 24 detailed and open-ended questions covering 16 pages. 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, 39 (68.4%) returned the second round, and 39 (68.4%) returned the third round. Forty-three panelists (75.4%) participated in two rounds (i.e., R1 and either R2 or R3), and 35 panelists (61.4%) participated in all three rounds. In addition, each participant received his or her responses that I initially intended to cite in future publications. The responses were sent to each panel member with relevant critical reflections. Forty-seven (82.4%) participants 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 process (the study) was composed of four rounds.

Formulating the Schemes

To be specific, the process of formulating the schemes was exhaustive (see Appendix B). It consisted of three steps. First, in the second round each panel member was asked to compile a knowledge map of the field, or rather a classification scheme, which represented his or her conception of Information Science. Next, in the third round, the investigator presented the panel's schemes, and each participant was asked to comment on the various schemes, select the one that best represented his or her position, and revise the scheme that he or she had developed in the second round. Finally, the investigator sent personal letters to the authors of the schemes. Each letter included the panel's relevant reflections, and if applicable, critical comments. Once again, each author was asked to revise his or her scheme.

The Panel's Schemes

Twenty-eight panel members contributed their schemes and reflections, which follow:

Aldo de Albuquerque Barreto

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1. Information Production and Organization
1.1 Information Nature, qualities & value
1.2 Production of stocks of information
1.3 Information management & control
1.4 Technologies & practices of information

2. Information Distribution
2.1 Users & information communities
2.2 Communication of information
2.3 Information sources
2.4 Channels of information & its flow

3. Information consumption and use
3.1 Information availability & access
3.2 Information Uses & Applications
3.3 Cognition Aspects of Information
3.4 Assimilation of information
3.5 The production of knowledge

4. History, Philosophy, Legal, Ethics, and Ancillary Aspects of Information
4.1 Legal Structure of Information (e.g., Copyright)
4.2 Ethics of Information
4.3 Policy & Politics
4.4 Globalization aspects
4.5 History, Philosophy, Environment

"***Reflections.*** *In my view, information science is a set of flows, processes and actions that starts in a generator's (author's) mind and ends in a space where users (receptors) appropriates that information to be knowledge. As it is a dynamic model I cannot see it in a static table where headers do not match the whole idea.*" [1] (Aldo Barreto)

Shifra Baruchson–Arbib

1. Foundations of IS
1.1 History of IS
1.2 History of Librarianship
1.3 Archival Science
1.4 History of knowledge Formats: Manuscripts, Print & digital
1.5 IS Epistemology

2. Methodology
2.1 Quantitative & qualitative research
2.2 Bibliometrics, Informatics
2.3 Bibliology
2.4 Domain Analysis
2.5 Webometrics

3. Information/Learning Society
3.1 Social & cultural aspects in the information society
3.2 Sociology of Knowledge
3.3 Social Communication
3.4 Scientific Communication
3.5 E-learning
3.6 Information Literacy
3.7 IS Education
3.8 Lifelong Learning

4. Information Technology
4.1 Communication & Computer networks.
4.2 Document Delivery Systems
4.3 Structure of Computerized Systems
4.4 Programming languages
4.5 Multimedia
4.6 Information retrieval Systems
4.7 Systems Analysis
4.8 Artificial Intelligence
4.9 Human Computer Interaction
4.10 Information Architecture
4.11 digital security systems
4.12 websites construction
4.13 Net works technologies
4.14 Knowledge Representation
4.15 search tools

5. Data organization & Retrieval
5.1 Classification Schemes
5.2 Metadata
5.3 Indexing
5.4 Abstracting
5.5 Knowledge organization
5.6 Taxonomies
5.7 Thesauri
5.8 Ontology
5.9 Vocabulary Control
5.10 Online Searching techniques
5.11 Reference work
5.12 The semantic web

6. Information industry Economic & Management
6.1 Competitive Intelligence
6.2 Databases
6.3 Digital Libraries
6.4 Electronic publishing
6.5 Information Industry Market
6.6 Information Management
6.7 Information Manipulation
6.8 Knowledge Management
6.9 Information centers & Libraries management.
6.10 Collection management
6.11 Electronic comers

7. Information Ethic and Law
7.1 Copyright
7.2 Digital Security
7.3 Digital divide
7.4 Censorship
7.5 Internet crime
7.6 Free Access to Information
7.7 Information Policies

8. User studies
8.1 Human Information Behavior
8.2 Information seeking Behavior
8.3 Information Needs
8.4 Reference interview
8.5 User- information scientist-interaction

9. Diffusion studies
9.1 Information Dissemination
9.2 Communication Theory
9.3 Message Theory
9.4 Information centres & Libraries

10. Social information Science
10.1 Information needs of Different cultures
10.2 Information Education, Power & ethics
10.3 Social information Banks
10.4 Social information sections in school & public Libraries
10.5 Self help sources-printed Electronic
10.6 The social information scientist
10.7 Community Information.
10.8 Information diffusion in multi cultural societies
10.9 Health information centres

[2] (Shifra Baruchson–Arbib)

Clare Beghtol

1. People
  1.1 By group:
   Community
   Culture
   Domain
   User group
 	
 1.2 By individual:
  Researcher
  User
 	
2. Object of Study
  2.1 By element:
   Data
   Information
   Knowledge
   Message
 	
  2.2 By conceptual foundation:
   Epistemology
   History
   Philosophy
   Practice(s)
   Theory
 	
  2.3 By purpose:
   Communication
   Creation
   Discipline area
   Dissemination
   Evaluation
   Management
   Organization
   Representation
   Retrieval
   Search
   Storage
	2.4 By methodology:
	  Qualitative
	  Quantitative
	
	3. Systems
	  3.1 By cultural factor:
	   Economic aspects
	   Education
	   Ethical aspects
	   Legal aspects
	   Professions
	   Societal aspects
	
	  3.2 By technology:
	   Electronic
	   Manual
	   Mechanical
	
	4. Space
	[by Universal Decimal Classification]
	
	5. Time
	[by Universal Decimal Classification]

*"**Rationale.** It's interesting that no one has produced a faceted (analytico-synthetic) system, so I've provided the basis for one... The fundamental facets are People, Object of Study, Systems, Space, and Time. These are subdivided into sub-facets and foci at a general level. It would need further conceptual development for sub-facets and foci, and a synthetic notation that would allow both inter- and intra-facet synthesis. The Universal Decimal Classification has been chosen for subdividing Space and Time because it is more highly developed in those areas than other general systems. Like other faceted systems, it is hospitable by nature and therefore potentially comprehensive. It is adequate and systematic. It is based on the most recent theoretical research in classification. It allows complex statements to be made using inter- and intra-facet synthesis (e.g.,"qualitative historical research on information organization in 19th century France compared to 14th century China" or "quantitative research on information practice by user groups in electronic systems for specific discipline areas").* [3] (Clare Beghtol.)

Maria Teresa Biagetti

1. Foundations of Information & Library Science
1.1 Information Science Epistemology
1.2 Information Theory
1.3 Cognition Theory
1.4 Semantics

2. Knowledge Organization
2.1 Theoretical foundations
2.1.1 Knowledge Representation
2.1.2 Categorization & Classification
2.1.3 Classification Theory
2.1.4 Subject Analysis
2.1.5 Indexing
2.2 Tools for Knowledge Organization and Library Science
2.2.1 Classification Systems
2.2.2 Ontologies
2.2.3 Thesauri
2.2.4 Vocabulary Control
2.2.5 Information Processing
2.2.6 Information Retrieval
2.2.7 Information Science Technology
2.2.8 Online searching
2.2.9 Search Engines

3. Measuring & Evaluation
3.1 Information Quality Evaluation
3.2 Bibliometrics
3.3 Informetrics
3.4 Webometrics

4. Social aspects
4.1 Information use and user
4.2 Readership Studies
4.3 Scientific Communication
4.4 Research Evaluation

*"**Rationale and structure.** The scheme is divided into four sections:*
1) Foundations. This section relates to Information Science as well as Library Science, since Information Science has its own foundations in the concept of "information" that needs reference to a cognitive system or a knowing subject. "Information" starts when signs are in connection with an interpreter. Similarly, Library Science relates to theories of mediating human knowledge and elaborating methodologies in order to connect external memories (books and documents) with human cognitive ability.
2) Knowledge Organization. This section is the core of the scheme. It has two subsections, without hierarchical structure. One subsection is concerned with theoretical foundations and methodological problems, the other subsection concerns the tools created in the field of Information and Library Science in order to organize the knowledge.
3) Measuring and Evaluation. This section accommodates the procedures elaborated to measure the realization and the use of bibliographical entities, electronic resources in the WEB, and to evaluate them.
4) Social aspects. This section is concerned with the social side of the Knowledge Organization: research strategies of the users, characteristics of the scientific communication, and so on." [4] (Maria Teresa Biagetti)

Manfred Bundschuh

1. Concepts	4.5 Information storing
1.1 Abstracting	4.6 Information structures
1.2 Artificial intelligence	4.7 Information use and user
1.3 Categorization & classification	4.8 Knowledge management
1.4 Classification theory	4.9 Metadata
1.5 Cognition	4.10 Online searching
1.6 Communication	4.11 Publishing
1.7 Competitive Intelligence	4.12 Scientific Communication
1.8 Digital preservation	
1.9 Digital security	**5. Information System Implementation**
1.10 Human information behavior	5.1 Data bases
1.11 Information Architecture	5.2 Information dissémination,
1.12 Information ethics	
1.13 Information Science Epistemology	**6. Quality assurance of Information**
1.14 Informetrics	6.1 Information Quality
1.15 Library Science	6.2 Information Science Education
1.16 Memetics	6.3 Research evaluation
1.17 Message theory	6.4 Testing of Software
1.18 Ontology	6.5 Quality assurance of Software
1.19 Operations Research	
1.20 Philosophy of Information science	**7. Applications**
1.21 Semiotics, Social, legal, & ethical aspects of information	7.1 Access systems
1.22 Taxonomies	7.2 Archival Science
	7.3 Aviation informatics
2. History	7.4 Bibliometrics
2.1 Foundations of information science	7.5 Community Informatics
2.2 History of information science	7.6 Diffusion of info studies
2.3 Indexing	7.7 Digital libraries
	7.8 Distributed networked environments
3. Information System development	7.9 Document Delivery Systems
3.1 Domain Analysis	7.10 Economics of information
3.2 Evaluation	7.11 Electronic Information Industry
3.3 Information need Evaluation	7.12 E-journals
3.4 Knowledge representation	7.13 E-learning
3.5 Knowledge structures Organization of Information	7.14 Health/Biomedical Informatics
3.6 Readership studies	7.15 Information industry
3.7 Subject analysis	7.16 Information technology
3.8 Systems analysis	7.17 Internet
3.9 Thesauri	7.18 Labor in information systems
3.10 Vocabulary control	7.19 Music-information-retrieval
3.11 Estimation of Info Tech projects	7.20 Philosophy of Librarianship
3.12 Sizing of Software	7.21 Public Information Policies
	7.22 Social information/Social Informatics
4. Information Processing	7.23 Information in traditional & User
4.1 High-Density Book Storage Systems	7.24 Web
4.2 Information manipulation	7.25 Webometrics
4.3 Information processing	
4.4 Information retrieval	**8. Information project management**
	8.1 Information management
	8.2 Management

[5] (Manfred Bundschuh)

Paola Capitani

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1. Thematic information
Biomedical information, Copyright, e-government, Economic information, Ethical aspects of information, Health & safety information, Legal information, Media information, Social information

2. Methodology
Knowledge representation, Organization of Information, Publishing, Search methods, Social Informatics, Standards, Team work, Terminology, Translation, methods, User needs, User satisfaction, Working group

3. Training
Information skills, Professional competences, Training courses, e-learning

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[6] (Paola Capitani)

Rafael Capurro

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1. Foundations of Information Science*
1.1 Philosophy of Information
1.2 The Concept of Information (Information Theory)
1.3 The Concept of Media (Media Theory)
1.4 The Concept of Message (Message Theory)
1.5 The Concept of Sign (Semiotics)
1.6 The Concept of Communication (Communication Theory)
1.7 Second-Order Cybernetics
1.8 System Theory
1.9 Cognition Theory (Social Epistemology)
1.10 Interpretation Theory (Hermeneutics)

2. History of Information Science

3. History of Media

4. Information Societies
4.1 Information Cultures
4.2 Information Behavior
4.3 Information Needs
4.4 Social Informatics
4.5 Scientific Communication

5. Information Systems
5.1 Information Architecture
5.2 Information Design
5.3 Multimedia Systems
5.4 Image Retrieval
5.5 Sound Retrieval
5.6 Mobile Computing
5.7 Ubiquitous Computing
5.8 Distributed Networks
5.9 Information Retrieval
5.10 System Analysis
5.11 System Evaluation
5.12 Library Systems
5.13 Public Media Repositories
5.14 Streaming Media
5.15 Mass Media
5.16 Archival Systems
5.17 Document Delivery Systems
5.18 Evaluation of Information Systems
5.19 Search Engines

6. Subject Analysis
6.1 Domain Analysis
6.2 Taxonomy Theory
6.3 Ontologies

7. Content Management
7.1 Knowledge Organization
7.2 Community Informatics
7.3 Competitive Intelligence
7.4 Computer mediated communication

8. Information Measurement
8.1 Informetrics
8.2 Bibliometrics
8.3 Webometrics
8.4 Scientometrics
8.5 Indicators for Research Evaluation

9. Economics of Information
9.1 Information Industry
9.2 Information & Media Products
9.3 E-Economy
9.4 Labor and Information

10. Information Ethics, Media Ethics
10.1 Theories of Information Ethics
10.2 Ethical Dilemmas in Information Society
10.3 Codes of Practice
10.4 Intercultural Information Ethics

11. Legal Aspects
11.1 Copyright
11.2 Censorship
11.3 Access

12. Information Policies
12.1 E-Government
12.2 E-Democracy

13. Education and Training
13.1 E-Learning
13.2 Information Science Education
13.3 User Education
13.4 Continuing professional education
13.5 Corporate Universities
13.6 Consultancy
13.7 Coaching

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*"**Delimitations.** Note that the order of this scheme does not imply any kind of practical or didactic order and importance."* [7] (Rafael Capurro)

Thomas A. Childers

Group 1:
Abstracting, Indexing, Knowledge representation, Metadata, Semiotics

Group 2:
Bibliometrics, Information diffusion, Human information behavior, Media use & users, Information need, Information use & users

Group 3:
Competitive Intelligence, Information dissemination, Information retrieval, Online searching, Knowledge management

Group 4:
Copyright, Publishing

Group 5:
Information systems analysis, Database creation, Human-computer interaction, Artificial intelligence

Group 6:
Information storage, Information structures, Information technology, Digital libraries, Distributed networked environments, Informatics

Group 7:
Document Delivery Systems, Information industry, Information management, Information processing

Group 8:
Economics of information, Information ethics, information policy

Group 9:
Management of Information Organizations, Operations Research, Evaluation of information systems

Group 10:
Information theory, Library Science

[8] (Thomas A. Childers)

Charles H. Davis

1. **Abstracting** (subsuming extracting)
2. **Classification and categorization** (subsuming ontology, taxonomy, domain analysis and similar terms)
3. **Indexing** (subsuming other terms implying in-depth content analysis)
4. **Cognition** (subsuming artificial intelligence and the like)
5. **Communication**
6. **Database management**
7. **Document delivery**
8. **Education & training**
9. **Ethics**
10. **Evaluation**
11. **History & foundations**
12. **Information theory**
13. **Legal aspects**
14. **Library science**
15. **Operations research**
16. **Publishing**
17. **Semiotics**
18. **Web & Internet studies**

[9] (Charles H. Davis)

Anthony Debons

1.	**Event**	4.9	Operations research
1.1	Subject Analysis (e.g. weather, medical diagnostics, market fluctuations, etc.)	4.10	Programization of Information
		4.11	Philosophy of computers
		4.12	Webmetrics
2.	**Acquisition**	4.13	Abstracting
2.1	Sensor systems (Optics, Radar, and Hearing aids could also be included under processing)	4.14	Electronic information industry
2.2	Classification, Categorization (of events)	**5.**	**Utilization**
2.3	Indexing (of events; examples: clouds, storms, crime, etc)	5.1	Artificial intelligence
		5.2	Cognition
2.4	Access system	5.3	E learning
		5.4	Human Information Behavior
3.	**Transmission**	5.5	Information ethics
3.1	Electronics	5.6	Information management
3.2	Cable	5.7	Information need
3.3	Wireless telephony	5.8	Information use & user
3.4	Electronic information industry	5.9	Aviation Informatics
3.5	transmission	5.10	Social, legal, ethical aspects of information
3.6	Distributed Networks		
		6.	**Transfer (communication)**
4.	**Processing**	6.1	Computer related communication
4.1	Biblimetrics	6.2	Librarianship
4.2	Data bases	6.3	Document delivery system
4.3	Digital libraries	6.4	E Journals
4.4	Domain analysis	6.5	Metalibrarianship
4.4	High density book storage systems	6.6	Scientific communication
4.5	Information manipulation	6.7	Readership studies
4.6	Information Processing	6.8	Social, legal, ethical aspects of information
4.7	Information storage	6.9	Archival science
4.8	Information structures	6.10	Community informatics

*"**Rationale.** The rationale of the model is based on three basic premises. First, all organisms are data, information, knowledge systems. They could not deal with the external world without them. Second, information is a state of consciousness (i.e., awareness). Thus, information is a cognitive/affective process and the products of that process (Miller, 1978). The focus is on the product and management of these processes (Drucker, 2001). Third, technology augments the human capacities and the products there from. (Englebart, 1962).*

Based on these premises, ontology of human organisms cam provide a map of the various relationships between an event (i.e., state of the world), the sensory mechanism that receive energy from the outside world, the movement (transmission) of these sensory impulses (transmission) to the brain (processors). The knowledge component of the augmented data information knowledge (ADIK) systems has reference to the formulation of judgment (i.e., decision/action) (Newell, 1972) that follows the processing of data-information. Decision incorporates an application of understanding, analysis, synthesis and evaluation (Bloom, 1956), the products of these processes are transferred (i.e., communicated) to others (e.g., cells, person, social entities) responding to various states of an event. The main role of the ADIK system is to respond to various states of the event world.

Information science establishes the law and principles that govern the relationships in the analysis, design, and evaluation of ADIK systems and wherein the basic premise, namely, such systems augment human processes, prevails (Debons et al., 1988)." [10] (Anthony Debons)

Nicolae Dragulanescu

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1. General

Economics of information, Foundations of IS, History of IS, Information ethics, Information management, Information Quality Management, IS Education, IS Epistemology, Information systems, Information technology, Social, legal, & ethical aspects of information

2. Information Generation Process

Databases, Information Architecture, Information structures, Informetrics, Organization of Information, Philosophy of Information science, Thesauri,

3. Information Processing, Storing & Communication Processes

Abstracting, Artificial intelligence, Categorization & classification, Communication, Indexing, Information processing, Information storing, Taxonomies

4. Information Use Process

Bibliometrics, Cognition, Decision making, Information dissemination, Information retrieval, Information use & user, Knowledge management, Problem Solving, Social information/Social Informatics, Subject analysis, Webometrics

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*"**Rationale.** The scheme represents the conception of information science as the science of information society (focusing on information systems); it studies the information and its five basic sub-processes – generation, processing, communication, storage and use - in order to optimize them. These processes are related to information as immaterial product and are representing the information cycle (within a research system). It is similar to the well known product cycle (within an economic system) with its three basic processes: production, distribution, and consumption. This is a managerial and pragmatic approach (Dragulanescu, 1999)"* [11] (Nicolae Dragulanescu)

Hamid Ekbia

Actors

People, institutions, professional organizations, research groups, funding agencies, and so on.

Practices

The activities that actors engage in when they use, categorize, mobilize, share, store, information

Methods

The moments or strategies that actors use when they engage in the above practices (some of which are already known and well-understood in science and elsewhere, and others of which will arise through the emerging practices and technologies)

Technologies

The reified objects that actors utilize in carrying out their activities (including, but not limited to, digital hardware, computer software, and so on)

Inscriptions: all kinds of representations that mediate among actors – e.g., references, citations, digital libraries, web pages (and any similar medium that may emerge).

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*"**Rationale.** The rationale behind my proposal derives from the lessons learned in the last few decades by the students of science studies, especially what has come to be known as "actor-network theory." Science, according to this view, is the outcome or performance of a heterogeneous set of actors, which are linked together in networks. A major premise of this view is that actors are not only human beings, but also non-humans such as, among others, technologies, documents, inscriptions, money, power, information, and so on. My separation of actors, inscriptions, and technologies in the following map should therefore be understood as a simplification."* [12] (Hamid Ekbia)

Alan Gilchrist

1.	**Foundations of IS**	**4.**	**Metrics, Evaluation & Research**	**7.**	**Application areas**
1.1	Classification theory	4.1	Evaluation of information systems	7.1	Information industry
1.2	Cognition science	4.2	Evaluation of retrieval	7.1.2	Electronic Publishing
1.3	Communication theory	4.3	User needs studies	7.1.3	Libraries
1.4	Foundations & history of IS	4.4	Usability studies	7.1.4	Digital libraries
1.5	IS epistemology	4.5	Diffusion studies, SNA	7.1.5	Primary Information Services
1.6	Library science	4.6	Economics of information	7.1.6	Secondary Information Services
1.7	Philosophy of information	4.7	Evaluation of information quality	7.1.7	Tertiary Information services
1.8	Museology	4.8	Biblio-, Infor-, Sciento-metrics	7.1.8	Intellectual capital
1.9	Archive science	4.9	Webometrics	7.1.9	Business intelligence
		4.10	Research methods	7.1.10	Geospatial Systems (GIS)
2.	**Technology**	4.11	Evaluation of research	7.1.11	Patent analysis
2.1	Buildings & equipment			7.1.12	Market research
2.2	Multimedia	**5.**	**Information use & users**	7.2	Discipline-oriented systems
2.3	Internet, intranets, extranets	5.1	Information needs & use	7.2.1	Chemical informatics
2.4	"High tech"	5.2	User typologies	7.2.2	Medical informatics
2.5	ICT	5.3	Information behaviour	7.2.3	Music information retrieval
2.6	Information processing tools	5.4	Group psychology	7.3.	Function-oriented systems
2.6.1	Classification schemes	5.5	Information usability	7.3.1	Marketing
2.6.2	Structured vocabularies	5.6	Info & IT literacy	7.3.2	Finance & accounting
2.6.3	Metadata & schema			7.3.3	Educational systems
2.6.4	Information & data models	**6.**	**Supporting disciplines**	7.3.4	Health informatics
2.7	Information workers	6.1	Management	7.3.5	Legal information systems
		6.1.1	Strategy & planning	7.3.6	e-Government
3.	**Activities**	6.1.2	Financial management	7.3.7	Citizen's information systems
3.1	Systems analysis & design	6.1.3	Human resource mgmt	7.4.	Media-based
3.1.1	Information (& knowledge) architecture	6.1.4	Facilities management	7.4.1	Text-based systems
3.1.2	Information (& knowledge) audit	6.1.5	Operations research	7.4.2	Pattern recognition
3.1.3	Website design	6.1.6	Decision support systems	7.4.3	Content-Based Image Retrieval
3.1.4	Typology & graphic design	6.1.7	Management information	7.4.4	Video systems
3.1.5	Standardisation	6.2	Mathematics & logic	7.4.5	Audio systems
3.2	Knowledge management	6.2.1	Bayesian probability	7.4.6	World Wide Web
3.3	Information management	6.2.2	Vector space analysis	7.4.7	Portals and gateways
3.3.1	Library management	6.2.3	Information theory		
3.3.2	Records & archives management	6.2.4	Bradford-Zipf analysis	**8.**	**Legal, Ethical & Social issues**
3.3.3	Document management	6.3	Linguistics & logic	8.1	Intellectual property
3.4	Museum documentation	6.3.1	NLP	8.2	Information ethics
3.5	Information processing	6.3.2	Computational linguistics	8.3	Freedom of Information
3.5.1	Information analysis	6.3.3	Semiotics	8.4	Data privacy, Censorship
3.5.2	Writing and journalism	6.3.4	Semantics	8.5	National information policy
3.5.3	Collection management	6.3.5	Speech recognition	8.6	Social exclusion
3.5.4	Indexing	6.4	Artificial intelligence	8.7	Third World problems
3.5.5	Abstracting	6.5	Psychology		
3.5.6	Cataloguing	6.6	Information politics	**9.**	**IS Education**
3.5.7	Classification & categorisation	6.7	Communication	9.1	Training
3.5.8	Information storage			9.2	e-Learning
3.5.9	Information curation				
3.5.10	Information retrieval				
3.5.11	Information dissemination				

[13] (Alan Gilchrist)

Information Phenomena at the various systems levels:

1. Information at the quantum level

Information processing subsystems: input transducer; internal transducer; channel and net; decoder; associator; memory; decider; encoder; output transducer

2. Information at the cellular level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

3. Information at the organ level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

4. Information at the organism level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

5. Information at the group level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

6. Information at the organization level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

7. Information at the society level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

8. Information at the supra-national level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

9. Information at the cosmological level

Information processing subsystems: input transducer; internal transducer; channel & net; decoder; associator; memory; decider; encoder; output transducer

*"**Rationale and structure.** The general systems levels and components stated above are adapted from J. G. Miller's brilliant synthesis of general systems theory (1995), but with the addition of a quantum level and a cosmological level. Each level has an associated subsystem level that processes information (other complementary subsystems at the different levels process matter and energy). The information processing subsystems for each level are these: input transducer; internal transducer; channel and net; decoder; associator; memory; decider; encoder; output transducer.*

***Quantum level.** Information at the quantum level relates to the properties of very small, sub-atomic particles that function not according to most prevailing notions of classical physics (which are based on classical or Newtonian models of three dimensions of space and one of time), but according to n-dimensional models of space-time. Quantum models generally portray very small particles as having the capability of moving backward or forward through linear time, being in two positions simultaneously, and possibly traveling or communicating at super-luminous speed (faster that the speed of light). When quanta collectively form patterns, quantum coherence can occur and can stimulate such things as neural microtubule receptors, and thus neural functioning and cognition (See Penrose, 1994)."*
[14] (Glynn Harmon)

1. Information Science Research

1.1 Concepts, definitions, theories, methodologies & applications

1.2 Properties, needs, quality, and value of information

1.3 Statistics, measurement (Bibliometrics, citation analysis, scientometrics, informetrics)

1.4 Information retrieval research (Searching techniques (Boolean, fuzzy, natural language), the search process, precision/relevance, ranking/recall, searching models, query formulation, inverted files, updating, database structures)

1.5 User behaviour & uses of information systems (Searcher tactics, information overload, user surveys, usability studies)

1.6 Human-computer interface (Human factors, ergonomics, design issues)

1.7 Communication (Editing, writing, linguistics, *Internet authoring & design principles*)

1.8 Operations research/mathematics (Modeling, Boolean logic, coding, systems analysis, algorithms, compression)

1.9 History of information science, biographies

1.10 Information genres

2. Knowledge Organization

2.1 Thesauri, authority lists (Taxonomies, ontologies, semantic networks, nomenclatures, terminologies, vocabularies)

2.2 Cataloging & classification (Tagging, metatags, Dublin Core, DOIs, OPACs, MARC, AACR2, topic maps, cataloging processes & theories)

2.3 Abstracting, indexing, reviewing Automatic indexing & abstracting

2.4 Standards & protocols (NISO, Z39.5, XML, SGML, HTML, Open Archives Initiative (OAI), Encoded Archival Description (EAD), Open URL, portable document format (PDF)

3. The Information Professions

3.1 Information professionals (Intermediaries, searchers, reference librarians, information brokers, translators, educators, librarians and librarianship, mentoring, career outlook, future of the profession professional ethics, skills & competencies)

3.2 Organizations & societies

4. Societal Issues

4.1 Information ethics, plagiarism, credibility

4.2 Information literacy, lifelong learning

4.3 The Information Society (Universal access & accessibility, technological & socioeconomic impacts of information, technology forecasts, information flows, futures scenarios, preservation)

5. The Information Industry

5.1 Information & knowledge management (Knowledge transfer in organizations, business strategies)

5.2 Markets & players (Vendor profiles & interviews, trends)

5.3 Economics & pricing (Business models, value chain)

5.4 Marketing, e-commerce

6. Publishing & Distribution

6.1 Print

6.2 Electronic (E-journals, e-books)

6.3 Secondary publishing (Abstracting & indexing services, directories)

6.4 Scholarly communication (Peer review process, future of journals, dissertations, grey literature

7. Information Technologies

7.1 Internet (World Wide Web, Invisible Web, Deep Web, search engines, browsers, hypermedia, Listservs, bulletin boards, portals, gateways,directories, pathfinders)

7.2 Intranets (private), Web conferencing

7.3 Software (Programming languages, operating systems, platforms)

7.4 Hardware

7.5 Multimedia

7.6 Document management (Imaging, scanning, text retrieval, digitization, records management, bookmarking, hypertext systems, preservation technologies, digitization, linking & electronic cross referencing, storage, digital rights management)

7.7 AI, expert systems, intelligent agents, (Cybernetics, visualization and mapping, data mining, pattern and character recognition, Search agents and robots)

7.8 Telecommunications (Networks, wireless & satellite information delivery, Palm Pilots & other PDAs, LANs & WANs)

7.9 Security, access control, authentication, encryption (Digital watermarking)

7.10 Other

8. Electronic Information Systems & Services

8.1 Information searching & retrieval systems & services (Bibliographic, numeric, &image databases; descriptions of online services)

8.2 Customized information systems, alerting, current awareness

8.3 Document delivery systems & services (Interlibrary loan, resource sharing)

8.4 Geographic information systems

9. Subject-Specific Sources and Applications

9.1 Physical sciences (Chemistry, physics, engineering, earth sciences, computer science, energy, mathematics)

9.2 Life sciences (Medicine, biosciences, agriculture, environment)

9.3 Social sciences, humanities, history, linguistics

9.4 Business (Management, economics, companies)

9.5 Law, political science, government Patents & trademarks, intellectual property, case law)

9.6 News

9.7 Education, library & information science, ready reference

9.8 Other/multidisciplinary (Biography & genealogy databases, encyclopedias, databases of theses & dissertations)

9.9 Countries & geographic areas

10. Libraries & Library Services

10.1 Library descriptions & types: Special, government, academic, & public libraries, archives, museums, State & National libraries, depository libraries

10.2 Library services

10.3 Library automation & operations

10.4 Library consortia & networks, coalitions, cooperatives

10.5 Digital & virtual libraries, hybrid libraries

10.6 Education & training (Distance learning, continuing education, bibliographic instruction library schools, courses & curricula)

10.7 Library Management, Planning & Personnel

10.8 Library facilities

11. Government & Legal Information & Issues

11.1 Intellectual property protection (Copyright issues & implications, fair use, trademarks, patent law)

11.2 Legislation, laws, & regulations (except copyright)

11.3 Contracts & licensing

11.4 Liability issues (Filtering, censorship, privacy)

11.5 Sources of public information

11.6 Information policies & studies (Security, encryption, privacy, freedom of information, censoring, national & other information policies)

11.7 Systems & infrastructure (Technology transfer)

[15] (Donald Hawkins)

Ken Herold

1. **Conceptions**	3. **Research & Evaluation**	7. **Organizations**
1.1 Artificial Intelligence	3.1 Bibliometrics	7.1 Electronic information industry
1.2 Categorization & Classification	3.2 Computer-mediated communication	7.2 Information industry
1.3 Classification theory	3.3 Diffusion studies	7.3 Publishing
1.4 Cognition	3.4 Evaluation	
1.5 Communication	3.5 Evaluation of information Systems	8. **Technologies**
1.6 Copyright	3.6 Information quality evaluation	8.1 Digital libraries
1.7 Domain analysis	3.7 Readership studies	8.2 Digital security
1.8 Information ethics	3.8 Research evaluation	8.3 Distributed networked environments
1.9 Information science epistemology	3.9 Webometrics	8.4 Document delivery systems
1.10 Information structures		8.5 E-journals
1.11 Information theory	4. **Education & History**	8.6 High-density book storage systems
1.12 Knowledge organization	4.1 Education & training	8.7 Information processing
1.13 Knowledge representation	4.2 E-learning	8.8 Information storing
1.14 Knowledge structures	4.3 Information science education	
1.15 Memetics	4.4 Foundations of information science	9. **Operations & Processes**
1.16 Message theory	4.5 History of information science	9.1 Abstracting
1.17 Metadata		9.2 Classification schemes
1.18 Ontology	5. **Resources**	9.3 Classification systems
1.19 Organization of information	5.1 Access systems	9.4 Competitive Intelligence
1.20 Scientific communication	5.2 Databases	9.5 Digital preservation
1.21 Social, legal &ethics aspects	5.3 Internet	9.6 Indexing
1.22 Subject analysis	5.4 Online searching	9.7 Information dissemination
1.23 Systems analysis	5.5 Web	9.8 Information management
		9.9 Information manipulation
2. **Disciplines**	6. **Environments/Cultures/Contents**	9.10 Informetrics
2.1 Archival Science	6.1 Chemical Documentation	9.11 Management
2.2 Economics of Information	6.2 Educational information	9.12 Taxonomies
2.3 Human information behavior	6.3 Health/Biomedical informatics	9.13 Thesauri
2.4 Information architecture	6.4 Labor in information systems	9.14 Vocabulary control
2.5 Information retrieval	6.5 Music information retrieval	
2.6 Knowledge management	6.6 Social information/social informatics	10. **Users**
2.7 Librarianship	6.7 Information in traditional & transitional societies	10.1 Information need
2.8 Library Science	6.8 Technological information	10.2 Information use
2.9 Metalibrarianship	6.9 Aviation Informatics	10.3 User
2.10 Operations research	6.10 Community Informatics	
2.11 Philosophy of computation	6.11 Public information policies	
2.12 Philosophy of information		
2.13 Philosophy of information science		
2.14 Philosophy of librarianship		
2.15 Semiotics		

[16] (Ken Herold)

Birger Hjorland

1.	**Disciplines & Sub-disciplines**	3.15	Metadata	**6.**	**Processes, entities & Institutions in Information Work**
1.1	Archival Science	3.16	Ontology		
1.2	Bibliography	3.17	Organization of Information	6.1	Communication
1.3	Bibliometrics	3.18	Paradigms	6.2	Computer mediated communicationn
1.4	Informetrics	3.19	Semantics & semantic relations	6.3	Databases
1.5	Information management	3.20	Semantic tools dictionaries, thesauri, classification schemes, ontologies etc)	6.4	Archieves, libraries, Museeums
1.6	Librarianship/Library Science			6.5	Digital libraries
1.7	Museology	3.21	Subject analysis	6.6	Digital preservation
		3.22	Subject access points	6.7	Distributed networked environments
2.	**Related fields**	3.23	Taxonomies	6.8	Documents
2.1	Cognition	3.24	Thesauri	6.9	Document Delivery Systems
2.2	Economics of information (Information management)	3.25	Vocabulary control	6.10	E-journals
		3.26	Words	6.11	Evaluation of information systems
2.3	Information theory			6.12	Full-text databases
2.4	Knowledge management	**4.**	**Domains**	6.13	Information dissemination
2.5	Semantics	4.1	Chemical Documentation	6.14	Information ethics
2.6	Semiotics	4.2	Culture	6.15	Information need
2.7	Literature studies	4.3	Health/Biomedical Informatics	6.16	Information processing
2.8	Sociology of science /sociology of knowledge	4.4	Geographical information	6.17	Information Quality Evaluation
		4.5	Medical information	6.18	Information retrieval
2.9	Science studies	4.6	Social science Information	6.19	Information sources
2.8	Systems analysis	4.7	Arts & humanities information	6.20	Information storing
		4.8	Legal information	6.21	Information use & user
3.	**Knowledge Organization**	4.9	Music-information-retrieval	6.22	Internet
3.1	Abstracting	4.10	Scientific Communication	6.23	Online searching
3.2	Categorization & classification	4.11	Technological information	6.24	Public Information Policies
3.3	Classification systems			6.25	Publishing
3.4	Concepts	**5.**	**Meta-issues**	6.26	Readership studies
3.5	Disciplines	5.1	Foundations of IS	6.27	Reference work
3.6	Domain Analysis	5.2	History of IS	6.28	Reference works
3.7	Genres	5.3	IS Education	6.29	Research evaluation
3.8	Indexing	5.4	IS Epistemology	6.30	Social information/Social Informatics
3.9	Information Architecture/Information structures	5.5	Philosophy of information	6.31	Information in traditional & transitional societies
		5.6	Philosophy of IS		
3.10	Knowledge	5.7	Philosophy of Librarianship	6.32	Social legal & ethical aspects of information
3.11	Knowledge Organizing Systems				
3.12	Knowledge production, dissemination & consumption			6.33	Subjects (e.g. Bradfords law)
				6.34	User
3.13	Knowledge representation			6.35	Web
3.14	Literatures (primary, secondary, tertiary etc)			6.36	Webometrics

*"**Delimitations.** A research into such issues is an ongoing process. My scheme, which reflects my theoretical orientation, will be expanded and revised in future research publications."* [17] (Birger Hjorland)

Michal Lorenz

1. Foundations of IS	**6. Knowledge organization**	**10. Diffusion studies**
1.1 Philosophy of Information	6.1 Categorization & Classification	10.1 Information Dissemination
1.2 Information Theory	6.2 Taxonomies	10.2 Communication Theory
1.3 IS Epistemology	6.3 Classification Systems	10.3 Message Theory
1.4 Philosophy of Computation	6.4 Classification Schemes	10.4 Memetics
1.5 Information Ethics	6.5 Retireval Languages	
1.6 Metalibrarianship	6.6 Subject Analysis	**11. Public Information Policies**
1.7 Library Science	6.7 Vocabulary Control	11.1 Free Access to information (Intellectual
1.8 Semiotics	6.8 Indexing	Freedom)
	6.9 Thesauri	11.2 Copyright
2. History of IS	6.10 Abstracting	11.3 Digital Security
	6.11 Metadata	11.4 Publishing
3. Information/Learning Society	6.12 Librarianship Standards	
3.1 Information Cultures		**12. User studies**
3.2 Sociology of Knowledge	**7. Information industry**	12.1 Human Information Behavior
3.3 Social Communication	7.1 Digital Libraries	12.2 Information Needs
3.4 Scientific Communication	7.2 Competitive Intelligence	12.3 Information Seeking
	7.3 Knowledge Management	12.4 Knowledge Structures
4. Information Systems	7.4 Information Management	
4.1 Information Architecture	7.5 Content Management	**13. Information Literacy & Education**
4.2 Information Design	7.6 Economics of Information	13.1 IS Education
4.3 Information Storing	7.7 Information Manipulation	13.2 Information Literacy
4.4 Access Systems	7.8 Information Quality Evaluation	13.3 Computer Literacy
4.5 Document Delivery Systems	7.9 Readership Studies	13.4 Educational Information
4.6 High-Density Book Storage Systems	7.10 E-journals	13.5 E-learning
4.7 Distributed Networked Environments	7.11 Operations Research	13.6 Lifelong Learning
4.8 Systems Analysis		
4.9 Evaluation of Information Systems	**8. Information retrieval**	**14. Applied Information Science**
	8.1 Electronic Information Sources	14.1 Librarianship
5. Information technology	8.2 Online Searching	14.2 Bioinformatics
5.1 Technological Information	8.3 Music-Information-Retrieval	14.3 Chemical Documentation
5.2 Information Processing		14.4 Health/Biomedical Informatics
5.3 Knowledge representation	**9. Quantitative analysis in IS**	14.5 Legal Informatics
5.4 Human Computer Interaction	9.1 Bibliometrics	14.6 Aviation Informatics
5.5 Computer Mediated Communication	9.2 Informetrics	
5.6 Artificial Intelligence	9.3 Webometrics	
5.7 Ontologies	9.4 Domain Analysis	
5.8 Databases		
5.9 Internet		
5.10 Community Informatics		

[18] (Michal Lorenz)

Ia McIlwaine

Group 1:	**Group 5: Management**
History of information science	Evaluation of information systems
Foundations of information science	Information management
Philosophy of information science	
	Group 6: Communication
Group 2: Information science epistemology	Cognition
Artificial intelligence	Human information behavior
Information structures	Information dissemination
Information technology	Readership studies
Information theory	
Informetrics	**Group 7: Copyright**
Knowledge structures	
Ontologies	**Group 8: Digital preservation & conservation**
Group 3: Librarianship	**Group 9: Archival Science**
Philosophy of librarianship	
Public information policies	
Publishing	
Group 4: Information retrieval	
Databases	
Categorization and classification	
Classification systems	
Subject analysis	
Indexing	
Metadata	
Thesauri	
Abstracting	
Vocabulary control	
Online searching	

[19] (Ia McIlwaine)

Michel Menou

1. Meta-IS	3.8 Online searching	**7. Societal Dimensions**
1.1 Disciplines & professions	3.9 Information dissemination	7.1 Social Informatics
1.1.1 Archival Science	3.10 Information visualization	7.1.1 In traditional & transitional societies
1.1.2 Library Science (or Librarianship)	3.11 Information Quality Evaluation	7.1.2 In technology intensive societies
1.1.3 Documentation	3.12 Information consolidation	7.2 Community Informatics
1.1.4 Labor in information systems		7.3 Information industries
1.1.5 IS Education	**4. Systems & Products**	7.3 Electronic Information Industry
1.2 Foundations of IS	4.1 Information generation systems	7.3.2 Publishing
1.3 Information theory	(e.g. blogs, Wiki, publishing)	7.3.3 Media industries (Newspapers,
1.4 Classification theory	4.2 Information storage & retrieval systems	radio, TV)
1.5 Information ethics	4.3 Documents management systems	7.4 Industry applications of IS
1.6 Philosophy of information	4.4 Access systems	7.4.1 Aviation informatics,
1.7 IS Epistemology	4.4.1 Web based products	7.4.2 Chemical Documentation
1.8 Philosophy of Computation	4.5 Document Delivery Systems	7.4.3 Health/Biomedical Informatics
1.9 Philosophy of IS	4.6 Digital libraries	7.4.4 Educational information
1.10 Philosophy of Librarianship	4.7 Databases	7.4.5 Scientific information
1.11 History of IS	4.8 E-journals & books	7.4.6 Technological information
	4.9 Evaluation of information systems	7.4.7 Bio-informatics
2. Primary Information Forms		7.5 Knowledge management
2.1 Data	**5. Information & Communication**	7.6 Information management
2.2 Documents	**Technologies**	7.7 Competitive Intelligence
2.3 Images	5.1 Analog technologies	7.8 Research evaluation
2.4 Tacit knowledge	5.2 Digital technologies	7.9 Information policy
2.5 Formal knowledge	5.2.1 Internet technologies	7.9.1 Public Information Policies
2.6 Formal information	5.2.2 Distributed networked environments	7.9.2 Corporate information policies
2.7 Informal information	5.2.3 Digital preservation	7.10 Economics of information
2.8 Indigenous knowledge	5.2.4 Digital security	7.11 Information Law
2.9 Stories	5.3 Media integration	7.11. Copyright
2.10 Genres	5.4 Mobile information technologies	7.11.2 Intellectual property rights
		7.11.3 Data protection
3. Information Processing	**6. Human Information Behavior**	7.11.4 Privacy
3.1 Contents representation	6.1 Information users	7.11.5 Freedom of information
3.1.1 Abstracting	6.2 Information uses	7.11.6 Information access rights
3.1.2 Indexing	6.3 Information needs	7.12 Measurements of information
3.1.3 Domain Analysis	6.4 Information seeking	7.12.1 Bibliometrics
3.1.4 Information structures	6.5 Information production	7.12.2 Informetrics
3.2 Knowledge organization	6.6 Information utilization	7.12.3 Webometrics
3.2.1 Knowledge representation	6.7 Computer-mediated communication	7.12.4 Scientometrics
3.2.2 Knowledge structures	6.8 Information support to learning	
3.2.3 Categorization & classification	6.8.1 By type of learning / learner	**8. Related Disciplines & Tools**
3.3 Organization of information	6.8.2 E-learning	8.1 Artificial intelligence
3.3.1 Subject analysis	6.9 Readership studies	8.2 Cognitive sciences
3.4 Information Architecture	6.10 Diffusion studies	8.3 Communication
3.5 Representation tools		8.4 Evaluation
3.5.1 Classification schemes & systems		8.5 Management
3.5.2 Ontologies		8.6 Operations Research
3.5.3 Taxonomies		8.7 Semiotics
3.5.4 Thesauri		8.8 Systems analysis
3.5.5 Vocabulary control		
3.5.6 Metadata		
3.6 Information storage		
3.7 Information retrieval (IR)		

[20] (Michel Menou)

Haidar Moukdad

1.	**Information studies**		**5.**	**Information Technology**
1.1	Theories & methodologies of IS		5.1	Online databases
1.2	Statistical analysis		5.2	Artificial intelligence
1.3	Information Retrieval		5.3	Hardware & software
1.4	User studies		5.4	Programming languages
			5.5	Internet technologies
2.	**Organization of Information**		5.6	Data mining
2.1	Indexing & abstracting			
2.2	Cataloging & Classification		**6.**	**Information professionals & services**
2.3	Meta data		6.1	Libraries & librarians
			6.2	Digital libraries
3.	**Information & society**		6.3	OPACs
3.1	Information acquisition		6.4	Information brokers
3.2	Continuing education		6.5	Professional schools
3.3	Communities		6.6	Trade publications
			6.7	Professional associations
4.	**The Information Market**			
4.1	Publishers		**7.**	**Legislations**
4.2	Consumers		7.1	Copyright laws
4.3	Publication media		7.2	Free speech
4.4	marketing & advertising		7.3	Court decisions
			7.4	Digital forensics
			7.5	Law enforcement

*"**Reflections.** The seven theme areas represent my understanding of how IS encompasses different areas of scholarships, professional activities, and technologies."* [21] (Haidar Moukdad.)

Dennis Nicholson

Group 1
1.1 Identification, 1.2 Behavior, 1.3 Characteristics, 1.4 Environmental context, 1.5 Use, 1.6 Management (includes description), 1.7 Impact, 1.8 Study methods (includes education, research, philosophy, information futures).

Group 2
2.1 Assessment and evaluation, 2.2 Control (includes storage, preservation, metadata etc), 2.3 Transmission, 2.4 Utilisation (includes information management aspects of comprehension, intake and retention by both practitioners & users, and also manipulation & processing)

Group 3
3.1 Tools, 3.2 Processes, 3.3 Systems, 3.4 Architectures.

Group 4
4.1 Every form that can be identified in the data – information – knowledge – message continuum

Group 5
5.1 All possible instantiations of each form - electronic data, electronic interactive, human & machine mediated, hardcopy forms etc.

[22] (Dennis Nicholson)

Lena Vania Pinherio

Group 1: Structural or Basic Disciplines	**Group 4: Technological Disciplines**
1.1 Domain analysis	4.1 Computer mediating communication
1.2 Foundations of Information Science	4.2 Databases
1.3 Information Science Education & training (including E-learning)	4.3 Data Mining
1.4 Information Science Epistemology	4.4 Digital/Virtual libraries
1.5 Inter & transdisciplinarity studies	4.5 Digital preservation
1.6 Information Theory	4.6 Digital security
1.7 Philosophy of Information Science	4.7 Document delivery systems
1.8 History of Information Science	4.8 E-journals
1.9 Bibliometrics, Informetrics, Webometrics/Netometrics (methodologies)	4.9 Information Networks
	4.10 Information Systems (access system, evaluation for information systems, system analysis)
Group 2: Instrumental Disciplines	4.11 Information retrieval systems (on line search)
2.1 Information architecture	4.12 Information technology
2.2 Knowledge organization (or information representation)	4.13 Internet/Web technologies
2.3 Abstracting	
2.4 Cataloguing	**Group 5: Socio – Cultural disciplines**
2.5 Classification (classification schemes, classification systems, classification theory)	5.1 E-Learning
	5.2 Information ethics
2.6 Taxonomy	5.3 Information need & use
2.7 Thesauri	5.4 User Studies
2.8 Vocabulary control	5.5 Scientific communication
2.9 Information processing	5.6 Social information/Information in traditional & transitional societies (division by culture, e.g. Africa), legal, & ethical aspects of information
2.10 Information storing	
2.11 Information structures	
2.12 Metadata	5.7 Information policy (copyright, intellectual property rights, privacy etc.)
2.13 Ontology	
2.14 Subject analysis	5.8 Public information policies
2.15 Automatic processing of language	5.9 Information Literacy
	5.10 Digital inclusion
Group 3: Management Disciplines	
3.1 Competitive intelligence	**Group 6: Information Applications**
3.2 Economics of information	6.1 Scientific information (all fields of knowledge)
3.3 Information dissemination (information products and services: bibliographies, catalogs, publishing)	6.2 Technological information
	6.3 Industrial information
3.4 Information management	6.4 Information in Art
3.5 Information quality evaluation	6.4 Archives information
3.6 Knowledge management	6.5 Library information
3.7 Marketing Information	6.6 Museums information

[23] (Lena Vania Pinherio)

Maria Pinto

1. Epistemological Archival Science, Classification Theory, Information Science Theory (Foundations, History, Epistemology, Education, Philosophy), Librarianship. **2. Systemic** Information Systems, Information Management, Knowledge Management, Information Policies, Systems Analysis. **3. Cognitive** Domain Analysis, Abstracting, Indexing, Classifications (Ontology, Taxonomies, Thesauri), Databases, Metadata. **4. Psychological** Economics of Information, Evaluation of Information Systems, Human information Behaviour, Information Quality. **5. Communicative** Communication, Copyright, Information Dissemination, Information retrieval, Message Theory. **6. Technological** Artificial Intelligence, Digital Security, Digital Libraries, Information Industry, Internet, Publishing, Web.

*"**Reflections.** It is almost impossible to elaborate an Information Science tree with clearly defined branches, because Information Science, as many others fields, does not have a tree structure, but rather a network structure. Therefore, dependencies and overlapping are an essential constituent of this multi-paradigmatic domain."* [24] (Maria Pinto)

Richard Smiraglia

1.	**Information (UF 'Information Science')**	**2.**	**Knowledge organization**
1.1	Information use & user	2.1	Knowledge representation
1.1.1	Memetics	2.2	Metadata
1.1.2	Social informatics	2.3	Knowledge structures
1.2	Information need	2.4	Ontology: classification
1.2.1	Applied informatics	2.5	Taxonomy: epistemology
1.3	Information architecture		
1.3.1	Information structures	**3.**	**Information retrieval (i.e. message)**
1.4	Philosophy of information	3.1	Information processing
1.4.1	Ontology	3.2	Document delivery
1.4.2	Epistemology		
1.5	Information policy	**4.**	**Information management**
1.5.1	Ethics	4.1	Competitive intelligence
1.6	Information theory	4.3	Information dissemination
		4.3.1	Economics of information
		4.3.2	Publishing
		4.3.3	Librarianship
		4.4	Information industry
		4.4.1	Information technology

[25] (Richard Smiraglia)

Carol Tenopir

1.	**Organization of Information & Knowledge**		**4.**	**Storage of information & knowledge**

1.1	Abstracting		4.1	Archives
1.2	Categorization & classification		4.2	Copyright
1.3	Classification schemes & systems		4.3	Digital preservation
1.4	Classification theory		4.4	Digital security
1.5	Indexing		4.5	Distributed networked environments
1.6	Information Architecture		4.6	Document Delivery Systems
1.7	Information processing		4.7	Information storage
1.8	Information structures		4.8	Preservation
1.9	Knowledge representation			
1.10	Knowledge structures		**5.**	**Information content & publishing**
1.11	Metadata		5.1	Databases
1.12	Ontology		5.2	Digital libraries
1.13	Organization of Information		5.3	Economics of information
1.14	Subject analysis		5.4	Electronic Information Industry
1.15	Systems analysis		5.5	E-journals
1.16	Taxonomies		5.6	Information industry
1.17	Thesauri		5.7	Publishing
1.18	Vocabulary control			

1. Organization of Information & Knowledge
1.1 Abstracting
1.2 Categorization & classification
1.3 Classification schemes & systems
1.4 Classification theory
1.5 Indexing
1.6 Information Architecture
1.7 Information processing
1.8 Information structures
1.9 Knowledge representation
1.10 Knowledge structures
1.11 Metadata
1.12 Ontology
1.13 Organization of Information
1.14 Subject analysis
1.15 Systems analysis
1.16 Taxonomies
1.17 Thesauri
1.18 Vocabulary control

2. Retrieval and use of Information & Knowledge
2.1 Access systems
2.2 Artificial intelligence
2.3 Domain Analysis
2.4 E-learning
2.5 Evaluation of information systems
2.6 Information dissemination
2.7 Information manipulation
2.8 Information needs
2.9 Information Quality Evaluation
2.10 Information retrieval
2.11 Online searching
2.12 Readership studies

3. Understanding users of information & knowledge
3.1 Bibliometrics
3.2 Cognition
3.3 Communication
3.4 Community Informatics
3.5 Competitive Intelligence
3.6 Computer-mediated communication
3.7 Diffusion studies
3.8 Human information behavior
3.9 Information use & user
3.10 Informetrics
3.11 Scientific Communication
3.12 Semiotics
3.13 Social information/Social Informatics
3.14 User Webometrics

4. Storage of information & knowledge
4.1 Archives
4.2 Copyright
4.3 Digital preservation
4.4 Digital security
4.5 Distributed networked environments
4.6 Document Delivery Systems
4.7 Information storage
4.8 Preservation

5. Information content & publishing
5.1 Databases
5.2 Digital libraries
5.3 Economics of information
5.4 Electronic Information Industry
5.5 E-journals
5.6 Information industry
5.7 Publishing

6. History & philosophy of IS
6.1 Foundations of information science
6.2 History of information science
6.3 Information ethics
6.4 Information Science Education
6.5 Information Science Epistemology
6.6 Information technology
6.7 Information theory
6.8 Philosophy of Computation
6.9 Philosophy of information
6.10 Philosophy of Information science
6.11 Philosophy of Librarianship
6.12 Public Information Policies
6.13 Message theory
6.14 Research evaluation
6.15 Information in traditional & transitional Societies
6.16 Social, legal, & ethical aspects of information

7. Managing information Organizations
7.1 Information management
7.2 Knowledge management
7.3 Knowledge organizations
7.4 Librarianship
7.5 Library Science
7.6 Management
7.7 Operations Research

[26] (Carol Tenopir)

Joanne Twining

Cultural, social, ethical, legal, economic, methodological, political, philosophical, theoretical, & technological processes & aspects of:

1.   Education for Library Information Science

2.   Metalibrarianship
2.1   Foundations, History, Theory, Philosophy of:
2.2   Information Science
2.3   Knowledge
2.4   Librarianship
2.5   Library Science

3.   Human Aspects
3.1   Cognition
3.2   Communication
3.3   Transfer
3.4   Education
3.5   Training
3.6   Uses
3.7   Behaviors

4.   Information
4.1   Architecture & Design
4.2   Documentation & Publishing
4.3   Preservation & Archiving
4.4   Organization & Representation
4.5   Abstracting & Indexing
4.6   Categorization & classification
4.7   Storage & Retrieval
4.8   Management
4.9   Systems & Networks

5.   Knowledge
5.1   Architecture & Design
5.2   Documentation & Publishing
5.3   Preservation & Archiving
5.4   Organization & Representation
5.5   Abstracting & Indexing
5.6   Categorization & classification
5.7   Storage & Retrieval
5.8   Management
5.9   Systems & Networks

6.   Research & evaluation
6.1   Bibliometrics
6.2   Informatics
6.3   Informetrics

[27] (Joanne Twining)

Irene Wormell

1.   Information Analysis
Quantitative analysis of information, Citation analysis, Informetrics, Bibliometrics, Webometrics, Subject & domain analysis, Publication analysis, Trend analysis, Innovation studies, (Databases), Diffusion studies, Information dissemination, Information manipulation, Research evaluation, Scientific Communication.

2.   Knowledge Organization
Abstracting, Access systems, Categorization & classification, Classification schemes, Classification systems, Classification theory, Domain Analysis, Indexing, Knowledge representation, Knowledge structures, Information structures, Ontology, Organization of Information, , Subject analysis, Systems analysis, Taxonomies, Thesauri, Vocabulary control.

[28] (Irene Wormell)

Discussion and Conclusion

Anthropological Document

Twenty-eight scholars compiled classification schemes. This unique collection portrays and documents the profile of contemporary Information Science at the beginning of the 21st century.

Delimitations. It is expected that a systematic mapping should be adequate, comprehensive, and systematic (see Appendix B, Item 4 for definitions of the foregoing terms.). This means that it is assumed that each scheme should adequately and coherently represent the conception of the field, as it is understood by the contributor. Meaning, it is assumed that every one of the 28 schemes demonstrates a distinct conception of IS. For example, if one asserts that IS explores all the aspects of the data, information, knowledge, message (D-I-K-M) phenomena, I would expect his or her scheme to include all the aspects of the D-I-K-M phenomena. Each scheme should be up-to-date and comprehensive; that is, it should represent all the key characteristics of the field (at least in the eye of the contributor). Additionally, each scheme should be systematic; namely, all the categories at each level are mutually exclusive (i.e., without overlaps) and collectively exhaustive (i.e., cover all the various aspects of the field). Many of the 28 schemes are adequate, comprehensive, and systematic, and are based on solid theoretical and philosophical foundations. However, a few are incomplete, inconsistent, and logically faulty. For this reason, the study is focused on an overall analysis, rather than on evaluating the accuracy, adequacy, comprehensiveness, and coherency of the panel's diversified definitions.

Types of classifications. The collection is composed of different types of classification schemes. For the benefit of readers who are not familiar with the terminology, let us specify the various types. Note that the various types are not mutually exclusive. Most of the schemes are taxonomies; namely, they are grounded on empirical data (e.g., schemes [8], and [9]). A few are typologies; namely, they are based on conceptual analysis of the constitutive concepts (e.g., scheme [3], and [12]). Scheme [10] is a two-level hierarchical classification. The first level is a six-category typology. The second level of each category is taxonomy. Most of the schemes are subject classification schemes designed for practical purposes, for example, scheme [15] was designed by Donald Hawkins, the editor of *ISA*. A few classifications are "ontologies"; namely, they are meant to divide the relevant phenomenon into its key attributes, characteristics, or facets. Clare Beghtol's faceted classification (see scheme [3]) is an ontology.

Six conceptions. In a previous study, I (Zins, 2007a) formulated six conceptions, or models, of Information Science. Theses models were identified and formulated based on analysis of 50 definitions of Information Science. The six models 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.); *the technology model*, (Information Science is the study of the mediating aspects of D-I-K-M phenomena as they are implemented in the technological domain in general, namely, all types of technologies.); *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.); *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.); *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 nonhuman.); and *the living & physical worlds* (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).

The mainstream 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*, and all are represented by the panel. However, the vast majority of the panel adopts the culture model. Evidently, the culture model represents the mainstream of contemporary Information Science.

This conclusion gets additional and unequivocal substantiation while analyzing the panel 28 classification scheme. Twenty-six schemes reflect the culture model. These are schemes [1], [2], [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [15], [16], [17], [18], [19], [20], [21], [23], [24], [25], [26], [27], and [28]. One scheme, [14] represents the living & physical worlds model. One scheme, [22], is too general, and can represent any model.

Knowledge Science. I have suggested changing the name of the field from *Information Science* to *Knowledge Science* (Zins, 2006). This study substantiates the suggestion. More than 20 schemes include the concept "knowledge" as a main category or a subcategory of the field.

Conclusions. To summarize, based on the panel diversified schemes it is evident that the culture model represents the mainstream of contemporary Information Science, which means that Information Science is the study of the mediating aspects of D-I-K-M phenomena—*mutatis mutandis*—as they are implemented in the cultural (i.e., social) domain. Apparently, the suggestion to change the focus of the field—as well as its name—from information to knowledge is supported by a growing number of scholars.

A Concluding Remark

This study documents 28 schemes of Information Science. This might help the reader to achieve better understanding of the issues and the considerations involved in establishing a solid, systematic, and comprehensive conception and knowledge map of the field; however, by no means does it replace the personal quest to ground one's positions on solid theoretical foundations.

Acknowledgments

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Appendix A

The Panel

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*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 Developing Subject Classification Schemes

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

2: Information Science Major Subfields and Key Concepts

Question 2.1 In this three-part assignment you will (a) list the most basic concepts, (b) list the major subfields, and (c) set a systematic classification of the field.

A. **List the (100) most basic IS concepts: Please check the following list (which was provided by the panel), erase duplications, add missing concepts, and if necessary rephrase the terminology. The list must be coherent with your conception of IS. Thanks. Your list:**

Abstracting, Access systems, Archival science, Artificial intelligence, Aviation informatics, Bibliometrics, Categorization and classification, Chemical documentation, Classification schemes, Classification systems, Classification theory, Cognition, Communication, Community informatics, Competitive intelligence, Computer-mediated communication, Copyright, Databases, Diffusion studies, Digital libraries, Digital preservation, Digital security, Distributed networked environments, Document delivery systems, Domain analysis, Economics of information, Education and training, Educational information, Electronic information industry, E-journals, E-learning, Evaluation, Evaluation of information systems, Foundations of information science, Health/biomedical informatics, High-density book storage systems, History of information science, Human information behavior, Indexing, Information architecture, Information dissemination, Information ethics, Information industry, Information management, Information manipulation, Information need, Information processing, Information quality evaluation, Information retrieval, Information science education, Information science Epistemology, Information storing, Information structures, Information technology, Information theory, Information use and user, Informetrics, Internet, Knowledge management, Knowledge organization, Knowledge representation, Knowledge structures librarianship, Library science, Labor in information systems, Management, Memetics, Message theory, Metadata, Metalibrarianship, Music information retrieval, Online searching, Ontology, Operations research, Organization of information, Philosophy of computation, Philosophy of information, Philosophy of information science, Philosophy of librarianship, Public information policies, Publishing, readership studies, Research evaluation, Scientific communication, Semiotics, Social information/social Informatics, Information in traditional and transitional societies (division by culture, e.g., Africa), Social, legal, and ethical aspects of information, Subject analysis, Systems analysis, Taxonomies, Technological information, Thesauri, User, Vocabulary control, Web, Webometrics.

B. **List the major subfields of IS: Copy your answer to A, erase duplications, add missing subfields, and if necessary rephrase the terminology. The list must be coherent with your conception of IS. [Note that if you prefer, you can skip B and move directly from A to C.] Your list:**

C. **Organize the major subfields of IS in a systematic order. Please copy your answer to B, erase duplications, add missing subfields, and rephrase the terminology (if necessary). Note that the result must be coherent with your conception of IS. Thanks. Your systematic list:**

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

4: Classification Schemes of Information Science

Requirements. Each scheme is required to meet the following necessary requirements:

(1) **Adequacy.** Each scheme should adequately and coherently represent the conception of the field, as it is understood by the contributor.
It is assumed that every one of the 29 schemes demonstrates a distinct conception of IS. For example, if you claim that IS explores **all** the aspects of D, I, K, or M, I would expect your scheme to include **all** the aspects of D, I, K, or M.

(2) **Comprehensiveness.** Each scheme should be up-to-date and comprehensive, that is, represent all the key characteristics of the field (at least in the eye of the contributor).

(3) **Systematic.** Each scheme should be systematic; that is, all the categories at each level are mutually exclusive (i.e., without overlaps) and collectively exhaustive (i.e., cover all the various aspects of the field).

Question 4.1
1. **Please revise your <u>preferred</u> scheme or formulate a <u>new</u> scheme. Please make sure that your scheme (a) adequately represents your conception of the field, (b) is comprehensive, and (c) is systematic. Thanks.**
2. **Please explain the rationale of your scheme. Thanks.**

Answer 4.1
1. **Copy your revised/new classification scheme here:**
2. **Formulate the rationale here:**

Question 4.2 If you have any comment or critical reflections, please let me know.
Note that I will send you (upon request) the panel's feedback regarding your scheme, so you will be able to revise it before the final report. Thanks.
Answer 4.2

Scheme 4[1]

NT Internet
  UF Web
NT Music-information-retrieval
NT Online searching
NT Labor in information systems
 	
4. Information Science
NT Information science, Foundations of
NT information science, History of
NT Information Science Education
NT Informetrics
  NT Bibliometrics
  NT Webometrics
  NT Scientific Communication
    NT Domain Analysis
 	
5. Knowledge organization
NT Knowledge representation
  UF Subject analysis
NT Metadata
  NT Abstracting
  NT Indexing
  [NT Cataloging]
NT Knowledge structures
NT Ontology
  [?] Classification
    UF Categorization and classification
    NT Classification systems
    NT Classification schemes
NT Epistemology
NT Taxonomies
NT Thesauri
  UF Vocabulary control
 	
6. Management
RT Knowledge management
UF Competitive Intelligence
RT Information dissemination
  NT Publishing
  NT Copyright
  NT Librarianship
    NT Metalibrarianship
 	
7. Philosophy
NT Ontology
NT Semiotics
NT Epistemology
Applications: Computation, Librarianship, Information
	1. Informatics
	NT Aviation informatics
	NT Community Informatics
	NT Health/Biomedical Informatics
	NT Memetics
	NT Social information/Social Informatics
	2. Information
	RT Communication
	  NT communication, Computer-mediated
	RT Message theory
	NT Human information behavior
	  RT Cognition
	NT Information Architecture
	NT Information dissemination
	  NT Publishing
	  NT Copyright
	  NT Librarianship
	    NT Metalibrarianship
	NT Economics of information
	NT Information ethics
	NT Information industry
	NT Information management
	  NT Information Quality Evaluation
	NT Information need
	NT Information Policies
	NT Information storing
	NT Information structures
	NT Information technology
	NT Information theory
	NT Information use and user
	  UF User
	  NT Information in traditional and transitional societies
	  NT Social, legal and ethical aspects of information
	NT Technological information
	
	3. Information retrieval
	NT Information processing
	  NT Artificial intelligence
	  NT Information manipulation
	  UF Programming
	  NT Access systems
	  NT Databases
	  NT Systems analysis
	    NT Operations Research
	NT Distributed networked environments
	  NT Document Delivery Systems
	  NT Evaluation
	NT Evaluation of information systems

Researcher's comments: The author of the scheme noted that this is a thesaurus rather than a classification scheme. We are looking forward to see how you will turn your thesaurus into a classification scheme. Please elaborate section 7 (Philosophy). Thanks.

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[1]The scheme was compiled by Richard Smiraglia, who replaced it with scheme [25] above.

Scheme 11[2]

1. **Information and knowledge representation and organization systems and theory**
   including categorization and classification systems, thesauri, subject analysis and vocabulary control, abstracting and indexing, knowledge structures and representation, metadata, etc

2. **Evaluation methods and theories**
   including evaluation of information systems, of research, of access systems, in general and of all subcategories etc.

3. **Foundations of knowledge and information science**
   including history, philosophy, theory, epistemology, in general and of all subcategories, etc.

4. **Human information and knowledge behavior and theory**
   including communication, creation, dissemination, management, manipulation, research, search and retrieval, use, users, etc

5. **Information and knowledge professions and theory**
   Including archival science, library science, etc.

6. **Social, legal and ethical theory and practices of all of the above**

Scheme 12[3]

Information Phenomena at the various systems levels:
1. **Cellular level,** e.g., Bioinformatics
2. **Organ level** e.g., medical or nursing informatics
3. **Organism level** e.g., cognitive science, biodiversity informatics, individual users
4. **Group level** e.g., social informatics
5. **Organization level,** e.g., management information systems
6. **Community level,** e.g., community health information systems (CHINs)
7. **Society level,** e.g., national defense information network
8. **Supranational level,** e.g., global news network
9. **Cosmological level,** e.g., NASA lunar information system
Each level would have associated input, internal processing, memory, output, etc.

Researcher's comments: An information system is a human artifact, which contains knowledge on the organism. What does information science explore? Is it the organism, or is it the human artifacts (i.e., the information system), which includes information on the organism? Logically, there are three options:

(1) IS explores the object/organism. If this is the case, then "Information Science" is a generic name, which includes, for example, astronomy (at the cosmological level), and biology (at the cellular, organ, and organism levels).

(2) IS explores human artifacts (i.e., information systems). If this is the case, then "Information Science" is a generic name, which includes, for example, the *NASA lunar information system* (at the cosmological level), and Bioinformatics (at the cellular, organ, and organism levels).

(3) Information science explores both, the object/organism and the information system. If this is the case, than "Information Science" is a generic name, which includes biology as well as Bioinformatics and medical information.

These are three different conceptions, which lead to three different information sciences. It seems that you follow the broadest (third) conception. If this is the case then you can further structure your scheme by dividing each level into two sub-categories: organism domain vs. information system domain.

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[2]The scheme was compiled by Clare Beghtol, who replaced it with scheme [3] above.
[3]The scheme was compiled by Glynn Harmon, who replaced it with scheme [14] above.