Information†

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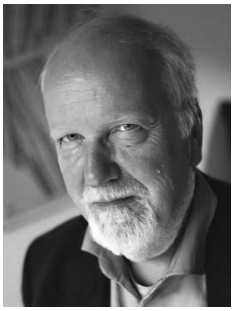

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Hjørland, Birger. 2023. "Information." *Knowledge Organization* 50(1): 47-79. 222 references. DOI:10.5771/0943-7444-2023-1-47.

Abstract: This article presents a brief history of the term "information" and its different meanings, which are both important and difficult because the different meanings of the term imply whole theories of knowledge. The article further considers the relation between "information" and the concepts "matter and energy", "data", "sign and meaning", "knowledge" and "communication". It presents and analyses the influence of information in information studies and knowledge organization and contains a presentation and critical analysis of some compound terms such as "information need", "information overload" and "information retrieval", which illuminate the use of the term information in information studies. An appendix provides a chronological list of definitions of information.

Received: 28 December 2021; Accepted 22 April 2022

Keywords: information, information theory, definitions

† Derived from the article titled "Information" in the *ISKO Encyclopedia of Knowledge Organization*, Version 1.3 published 2022-10-05: last edited 2022-10-24. Article category: Theoretical concepts

1.0 Introduction

The term "information" is a polysemic and vague word.[1] To neglect considering its meaning may be a bad choice, as Burgin (2010, vii) suggested:

> [O]ur experience demonstrates that mundane understanding of the notion of information may be very misleading. For instance, many identify information and message. However, receiving a message that consists of a random sequence of letters, a person gets no information. Thus, there are messages without information. Another example that demonstrates that a message and information are distinct essences is a situation when one and same message gives different information to different people. So, as it often happens in science, to overcome limitations of the commonplace image of information, the main problem is to find or to build the right theory.

The claim in this quote that the same message may inform people differently seems not only to be valid, but to be intimately connected with the core purpose of the present article, although the first element of it has been questioned.[2]

As Qvortrup (1993, 3; italics in original) wrote, information "*seems* to be innocent, because everybody talks about information, information technology and an information society. It *is* however significant because its definition implies a whole theory of knowledge".[3]

Much confusion arises from simple questions such as: "what is information?", "what is information science about?"[4] and "what is an information specialist a specialist in?" "Capurro's trilemma" (Capurro, Fleissner and Hofkirchner 1999) suggests that we must understand the meaning of information in different domains in one of three ways:

1. Univocity: it has the same meaning in all contexts.
2. Analogy: it has one true meaning in a specific context but may be applied as an analogy in others.
3. Equivocity: it may have multiple, equally valid meanings in different contexts.

About these possibilities, Bawden and Robinson (2020, 8) found: "The first is plainly unhelpful, if not simply incor-

rect. The second lends itself to overly simple analogies, and the third makes any unified theory impossible, and any gap-bridging impossible". The present article suggests a combination of these options: It is possible to define information as a universal phenomenon (e.g., as Bateson's 1972, 453, "information is a difference which makes a difference"), however such definitions imply that what is information always depends on a specific organism or system and is therefore context specific. The term is also theory-dependent and may be considered a very good example of "semantic holism", the view that the meaning of signs, including words, is relative to the theories and contexts in which they are used.[5] By implication the meaning of the term information should not be sought in the term itself nor in its etymology, but in the theoretical framework in which we wish it to play a role (or even broader: the meaning of terms comes from the forms of life with which they are interwoven).[6]

This principle of semantic holism has determined he selection of theories about information presented in this article. It is not possible to make an exhaustive summarization of every definition written about *information* neither in general nor just for library and information science (LIS). It seems a bad choice to delimit the coverage by formal criteria such as dates, disciplines, or regions because the most relevant views do not come from a particular time, discipline, or region, but traverse these formal settings. In Appendix 1, however, a comprehensive chronological sample of definitions and brief statements of information is given. This is intended as a tool for further research about the information concept.

This article is especially concerned about the term "information" in relation to "information science" (or "information studies" or LIS, including "knowledge organization", KO), although with a perspective from the broader meanings of the term. We will examine the history of the term in these contexts and ask why the term was introduced in the first instance. We shall also consider whether it is needed at all, or whether other terms may better and more precisely replace it.

2.0 Elements of a history of the term information

Capurro has done work tracing the epistemology of the term "information" from Greek, Latin, Arabic, Persian, and Hebrew Roots. Capurro (2019) is a short summary in English with references to more detailed studies (including Capurro 1978). In Capurro and Hjørland (2003, 352; italics in original) he wrote:

> Several Greek words were translated with *informatio* or *informo*, such as *hypotyposis* (which means *model*, especially in a moral context) and *prolepsis* (representation), but most higher-level uses are explicitly related to eidos, idea, typos, and morphe; that is, to key concepts of Greek ontology and epistemology.

Capurro's description of the history is very complex and difficult to summarize, and he concludes that the word is untranslatable, which is used as argument for the third possibility (equivocity) in Capurro's trilemma. Here we will rely on a summary provided by Adriaans and van Benthem's (2008, 4):

> The term information is of Latin origin, and authors like Cicero and Augustine used it in the context of Plato's theory of ideas (or forms) and its successors. In particular, Cicero uses 'in-formare' to render the Epicurean notion of 'prolepsis', i.e., a representation implanted in the mind (Capurro and Hjørland, 2003). In the Middle Ages, a significant shift occurred. In the century, the French word 'information' emerges in colloquial language with a cluster of meanings: 'investigation', 'education1, 'the act of informing or communicating knowledge' and 'intelligence'. The technical term 'information' then vanishes from philosophical discourse as though it had lost its appeal. Instead, when the English empiricists went back to the original Platonic inspiration, they coined the term 'idea' (derived from Platonic 'eidos'): "whatsoever is the object of understanding when a man thinks . . . whatever is meant by phantasm, notion, species, or whatever it is which the mind can be employed about when thinking" (Locke, 1961, Essay I,i,8). The philosophical adventures of this notion of 'idea' run from Hume, Kant, and the German idealists up to Husserl and beyond. But like famous cats through history, 'information' has had many more lives than just one [presented in subsequent paragraphs].

Peters (1988) also describes the history of the term but used Wittgenstein's theory of language games as the point of departure. He found:

> The term developed through four main forms of life, traveling from the late medieval Schools through the essays of the British empiricists to the statistical data of state bureaucracies and today's computer technology. The shifts in sense it undergoes are profound and dizzying, and yet in each case there is a sort of logic as to how one form of life, one cluster of senses, gives way to another.

In the environment fashioned by Aristotle's disciples in the late Middle Ages, *informatio* and *information* were used in a broad sense to account for the way that the universe is ordered. According to the interpretation of Aristotle, matter

is always the same four elements (earth, water, air, and fire).[7] Therefore, all objects are primarily characterized by their form, they are brought into form, informed, and when an object perishes, only the form disappears, not the matter. (A view known as hylomorphism from Aristotle's *hyle*, or matter, and *morphe*, or form). The English term information in the fourteenth century also carried the meaning to instruct (from Latin informare) and idea, instruction, concept, doctrine (from *informatio*) and, as still used: an item of new knowledge.[8]

With empiricism the view of the universe as ordered by form fell into disrepute, and the context of the in-forming shifted from matter to the mind, a shift from metaphysical forms to the evidence of the senses, so objects in the world came to in-form the senses. But empiricism has a problem by explaining how valid knowledge can be derived from the uncertain light of the senses. The empiricist problematic was (and still is) how the mind is informed by sensations of the world. Peters (1988, 13; italics in original):

> In any case, the empiricist problematic was how the mind is informed by sensations of the world. At first *informed* meant *shaped* by; later it came to mean *received reports from*. As its site of action drifted from cosmos to consciousness, the term's sense shifted from unities (Aristotle's forms) to units (of sensation). *Information* came less and less to refer to internal ordering or formation, since empiricism allowed for no preexisting intellectual forms outside of sensation itself. Instead, *information* came to refer to the fragmentary, fluctuating, haphazard stuff of sense. *Information*, like the early modern world view more generally, shifted from a divinely ordered cosmos to a system governed by the motion of corpuscles. Under the tutelage of empiricism, *information* gradually moved from structure to stuff, from form to substance, from intellectual order to sensory impulses.

Whereas classical empiricism was an individualistic philosophy, in which information was considered the experience of the individuals, Peters' third main change is due to the statistical data of state bureaucracies. Individual empiricism is being replaced with "state empiricism". Although bureaucracy is as old as civilization, "the scale and intensity of bureaucratic growth over the last two hundred years is quite unprecedented in human history. And the essence of bureaucracy is information: here we come to a sense of the term that is completely ours and requires neither mind-stretching nor italics". And further (15): "The *Oxford English Dictionary*'s recent definition of *information* as facts or knowledge 'separated from, or without implication or reference to a person informed' is not an artifact of computers. Statistics long functioned as knowledge processed by an inanimate, unembodied knower" (corresponding to Buckland's *information-as-thing*, presented below).[9]

Peters' fourth stage relates to computer technology and especially to Shannon's information theory. Although this theory was explicit about signals, and not about *significance* or *meaning*, this reservation was forgotten as the theory diffused through American intellectual life. One implication of this was that *the great chain of being*[10] was rewritten in informational terms, from the DNA code containing genetic information over the neural synapses as switchboards and nerves as telephone lines to the human brain as an information processor. In the social world we hear that marriages will work better if men and women "share information about their feelings". (It can be added to Peters' examples, that libraries became "information storage and retrieval systems", see Hjørland 2015). Peters' description seems to echo a claim made by Machlup's (1983, 642), that information came to be used in a metaphorical sense, not in its denotative meaning.[11] Buckland (1991b) argued however, that Machlup's understanding (as those of many other authors) is too narrow by restricting information to what is intentionally told. Thus, Buckland convincingly argued that something can be informative (or information), whether or not this was intended, or even of human or biological origin.

Shannon's theory (Shannon 1948, Shannon and Weaver 1949) was a further development of ideas by Hartley (1928) and Nyquist (1924), who introduced fundamental ideas related to the transmission of information in the context of the telegraph as a communications system. This theory has had enormous influence on the discourses about information and on the formation of information science as a field of study (to be further discussed below). It defined information as a measurable quantity (e.g., number of bits on a disc drive), but without considering the meaning of the information. (According to this theory nothing can be misinformation.)[12] This theory is often understood to define information in terms of entropy, which in popular terms can be understood as a measure of the disorder or randomness of a system.[13] Shannon's theory lost much of its initial appeal in fields working with meanings (although today it plays a role in Floridi's General Definition of Information (GDI), which, however, is not immune to the same kind of criticism as Shannon's theory (see "3.5 Floridi's philosophy of information" in Hjørland 2018c, 322-3). It is an implication of this theory that the amount of information in a given code is proportional with the amount of information it contains.[14] (Bremer and Cohnitz 2004 abandoned the measurement of amounts of information).[15]

However, as Burgin (2010, vi-vii) expressed, the term information continues to be broadly used without clear definitions:

> During the last fifty years or so, the term information succeeded in pervading science, technology, humanities, economy, politics, as well as everyday life. Governments, companies and some individuals spend vast fortunes to acquire necessary information. However, there are many problems with this term. As Goguen writes (1997), "we live in an "Age of Information"," but it is an open scandal that there is no theory, nor even definition, of information that is both broad and precise enough to make such an assertion meaningful.

Buckland (1991a; 1991b; 1997; 2012; 2018) proposed a typology of categories of the word information:

- information-as-knowledge for knowledge imparted, what was learned as a result of being informed;
- information-as-process for becoming informed, for learning;
- information-as-thing for bits, bytes, books, sounds, images, and anything physical perceived as signifying. The word "document", which was not historically limited to textual media, can be used as a technical term for information-as-thing.[16]

As he points out, the only thing that can be stored and retrieved in any kind of information system, is information-as-thing (which of theoretical reasons may better be termed documents). We have seen Peters' explanation for how the term "information" developed to refer to things. Haigh and Haigh (2013) also addressed this question.

Information has also been understood as an economic resource and commodity. Two important contributors to this conception are (Porat 1977)[17] and Machlup (1962;[18] 1980). It became influential, for example, by the term *information resource management* (see Eaton and Bawden 1991).

If we consider information-as thing, *which* things are then information, and which are not? When we ask what a thing informs about, we need to realize that this depends on the questions put to it. We must also realize that what questions one is able to put to a thing depends on one's knowledge and resources. Today, for example, we can put new questions to specimens in zoological museums because of DNA techniques, and such analyses inform us about biological taxonomy. Any specific thing may always be reinterpreted and answer new questions. Therefore, we may say with Buckland (1991a, 50; italics in original) "We conclude that *we are unable to say confidently of anything that it could not be information*". In other words, anything can be informative and thus information for a given question/situation and provide new kinds of information for new questions/situations. If anything is information, is it then an empty word? How can information then be studied? To cope with this problem, it is necessary to understand that a given thing is only informative in relation to a specific perspective.

Bateson (1972, 453) provided an important definition: "information is a difference which makes a difference".[19] This means, for example, that an animal that is adapted to an organic niche has developed senses and brain mechanisms which, for this species, are designed to identify differences in the environment, that is of importance for it, and inform the animal. Other differences in the environment may be ignored and are not information for the animal.[20] For human beings, it is not primarily the characteristics of the species, that determines which differences are informing the individuals, as it is the cultural and social learning, including the social division of labor and the scholarly traditions in which the individuals have been trained. An expert with a specialization within history of books, for example, may be informed by differences in books, that are not informative for laypersons, and a chemist may perform analyses of the paper which may answer questions that neither the book historian nor the layperson can answer. Theoretically, as already said, any difference may be informative for somebody. It follows that the communication of information in relation to given objects cannot be done objectively but must always be a selection of possible answers done to facilitate certain actions for which the object becomes a tool.

The number of views about information is overwhelming, and so are the attempts to provide overviews and taxonomies of information concepts, such as McKinney and Yoos (2010) who concluded that the lack of a unifying philosophical outlook has produced a preparadigmatic state of flux.[21] But here we find that Bateson's definition is a very fruitful point of departure.

3.0 Relations between information and other concepts

In this section we consider the relations between the term information and the following other terms: matter and energy, data, sign and meaning, knowledge, and communication. Other terms might also have been included, but the chosen terms seem especially important to delimit the meaning of information (e.g., explore if information is used as a synonym for some of these terms). Matter and energy are discussed because it seems important to consider whether information is a fundamental category in the universe on par with these concepts. The most frequently associated terms are those in the so-called DIK-pyramid: data, information, and knowledge (sometimes wisdom[22] is added: DIKW-pyramid). This pyramid is therefore discussed, and it is argued that sign and meaning should not be neglected. Finally, communication has been added on the suggestion of a peer-reviewer.

3.1 Matter and energy

Karpatschof (2000, 129-32) defined information as a quality of a given physical signal relative to a certain release mechanism. The release mechanism is sensitive to a specific signal as a lock to a key, and it has a store of energy and is "designed"[23] to let this energy out in specific ways whenever triggered by a signal fulfilling the specifications of the release mechanism. The signal has a low energy compared with the energy that the release mechanism lets out. The release mechanism may be understood (my interpretation) as a sign processing unit, and it has a double function: (1) it reinforces the weak signal and (2) it directs the reaction by defining the functional value of a signal in the pre-designed system of the release mechanism ("information processing" mechanism or unit). Karpatschof's view thus corresponds with that of Wiener (1948, 155): "Information is information, not matter or energy" (or the other way round: matter and energy is not information, a view that seems to have been challenged. Chaitin (1999), for example, suggested that information is primary in relation to matter;[24] see also Endnote 25).

It is always possible to build a mechanism, that is sensitive to a given signal (or to any given difference to use Bateson's term) because anything might be information. Information is therefore not some specified elements or parts of the world, again: anything can be information, and it is not possible to say what is information (and what is not information) unless in relation to a specified release mechanism. This agrees with the formerly quote from Buckland (1991a, 50; italics in original), which said that anything might in some imaginable circumstances be informative: "*We conclude that we are unable to say confidently of anything that it could not be information*".

Karpatschof thus defines Information in physical terms as signals fulfilling certain requirements. However, the mechanisms relative to whom information is defined, probably first evolved in living organisms. As we shall see in Section 3.3 instead of "signal", we may speak of "sign" and instead of "release mechanism" we may use "interpretant", whereby we use a terminology that better fits both the physical, the cognitive and the cultural sphere, although still maintaining the idea of a causal relation between "objects" and "information".

3.2 Data

Information is sometimes defined as processed data. ISO 5127:2017, definition 3.1.1.16, for example reads:

> Information: data (3.1.1.15) that are processed, organized and correlated to produce meaning (3.1.8.03).

This definition is part of the so-called "knowledge pyramid" (also known as the DIKW hierarchy: Data, information, knowledge, wisdom hierarchy, see Frické (2019)). But although this pyramid is rather popular in the literature of more information sciences, it is nonetheless deeply problematic.[26] Information cannot be defined as processed data just as knowledge cannot be defined as processed information. These three terms are all defined by the ISO 5127 standard, but the definitions are circular and therefore unhelpful (ISO 5127 defines data as "reinterpretable representation of information ...", so we have not learned what information is because it is defined by a term (data), that presupposes that we know what the term information means.

An alternative definition was provided by Kaase (2015, 830):

> Data are information on units of analysis or observation.

For example, the mass of a thing is measured in kilograms according to *the International System of Units*, so the information that a given object has the mass of 2 kg can be given as a datum, but it is also informative, it is also information. Information is the broader term, since data represent only the kinds of information which provide "information on units of analysis or observation". (Other examples, which do not refer to international standards could also be used). See further about data in Hjørland (2018a) and Schöpfel et al. (2021). We conclude with Buckland (1991b) that a datum, if recorded, is a kind of information-as-thing or in another word: a kind of document.[27]

3.3 Sign and meaning

Already by the 1950s, some authors found Shannon's (1948) information theory too narrow, failing to provide a semantic understanding of information. Bar-Hillel and Carnap (1953) attempted to develop a theory that included the semantic dimension. Later MacKay (1969) stated that the concept of information is inseparable from the concept of meaning. Since then, there has been a growing, but scattered interest in the concept of meaning in the study of information.

Signs and meanings are studied by semiotics, and although that study has a long history, Charles Sanders Peirce's view is here taken as the most important one. According to Peirce, there is a basic triadic relation between signs (or "sign-vehicles"[28]), objects and interpretants. Among Peirce's many definitions, is the one suggested in Peirce 1897 (CP 2. §228):

> A sign, or representamen, is something which stands to somebody for something in some respect or capacity. It addresses somebody, that is, creates in the mind of that person an equivalent sign, or perhaps a more

> developed sign. That sign which it creates I call the interpretant of the first sign. The sign stands for something, its object. It stands for that object, not in all respects, but in reference to a sort of idea, which I have sometimes called the ground of the representamen.

Or, more briefly: a sign "is something which stands to somebody for something in some respect or capacity".[29] It should be mentioned that Peirce's concept of sign included thoughts, but still Karpatschof's explanation is relevant because for both him and Peirce it is the causal connection between signs and what it signifies that is important.

Hjørland, (2013, 229) suggested that the general development in information science can be characterized by a movement from information theory (Shannon and Weaver 1949) towards semiotic theories, as also argued by, for example, Gorn (1968), Pearson and Slamecka (1983), Wersig (2003) and Brier (2008). In other words, it has developed towards theories of signs, languages, and meaning in a social perspective.[30] What Wersig (2003, 312) wrote was:

> The very notion of semiotics, which in fact became one of the most important critiques of too simple an application of information theory to human communication, led to the insight that Shannon's mathematical theory was only a theory on the syntactical level (relation of signs to signs), but with no reference to the semantic (relation of signs to meanings) and pragmatic (relation of signs to humans) levels. In consequence, some attempts were made to develop out of Shannon's theory a semantic (e.g. Bar-Hillel and Carnap 1953) or pragmatic (e.g. Yovits 1975) information theory, but these remained in the literature with no great success.[31]

Hjørland (2021) found that Kuhn's theory of paradigms agrees with the semiotic view, and it illuminates how the meaning of signs (e.g., scientific terms) depends on the paradigm of which they form part. It should also be repeated here that Peters (1988) considered the meaning of signs in the perspective of Wittgenstein's philosophy as relative to forms of life.

It should be mentioned that the term *document* also has been defined semiotically (Buckland 2018, 427) and document theory can be seen as an important part of the change of information science from Shannon's information theory to semiotics.

3.4 Knowledge

ISO 5127:2017 defines knowledge in definition 3.1.1.17: "Maintained, processed, and interpreted *information* (3.1.1.16)", but we have already considered the problem with these circular definitions in the "DIKW-hierarchy". In philosophy there are different views about the meaning of the term knowledge. Most influential is Plato's definition: "knowledge is justified, true belief" (in the dialogue Theaetetus, written circa 369 BCE). However, according to the principle of fallibilism, no scientific theory or statement can ever be considered fully verified. By implication we should never consider something "knowledge" (in Plato's sense) but just "a knowledge claim". The study of knowledge is performed in, among other fields, epistemology, sociology of knowledge, semiotics, psychology and cognitive sciences. Important discussions are about issues of objectivity and neutrality of knowledge (claims), which are highly important for all fields involved with the production, management, mediating and use of knowledge and information, and therefore depends on the implicit or explicit view of knowledge on which they are based.[32]

Can knowledge be understood as the contents of books and articles in, for example, the scientific and scholarly literature? We speak of knowledge production at universities, and in the philosophy and sociology of knowledge, the term knowledge is often used about content of a scientific document. In information retrieval, however, we mostly use the term "information" about the documents being retrieved. The claim supported in the present article is, however, that the field of information retrieval would benefit by considering the knowledge developed by disciplines such as epistemology, sociology of (scientific) knowledge and history of (scientific) knowledge. Therefore, the focus on the term information and its associated disciplines has brought too narrow a focus in the information sciences. What is retrieved in an "information retrieval system" are documents, which contain "potential information" or "knowledge claims". To examine the status and relevance of the retrieved documents, and thereby to establish criteria for their retrieval, we need to attend to the disciplines studying knowledge. As argued in Section 4.1. this is an argument for preferring the term "knowledge organization" rather than "information organization". (Some authors have replaced the term "information" with the term "knowledge", or discussed replacing it, in relation to information retrieval and information science, e.g., Kemp (1988) and Zins (2006; 2007).

3.5 Communication

Communication is often understood as the process of transmitting information. The *Oxford English Dictionary* (OED), for example, states:

> Sense 5b: spec. The transmission or exchange of information, knowledge, or ideas, by means of speech, writing, mechanical or electronic media, etc.; (occasionally) an instance of this.

As the transmission of knowledge and ideas are also about transmission of information, this definition in reality states that communication (sense 5b) is the transmission of information, which is supported by:

> Sense 5c: plural. The science, practice, or system of transmitting or imparting information, esp. of doing so over a distance by electronic or digital media. See also telecommunication n.

Communication is, however, sometimes understood in a broader sense about transmitting of physical objects. In this broader sense, railways and postal services understood as parts of the communication infrastructures of society. OED:

> 5. a. The action of communicating something (as heat, feeling, motion, etc.), or of giving something to be shared; an instance of this. Cf. communicate v. 1. Now rare with reference to material objects, except as the vehicles of information (letters, papers to learned societies, magazine articles, etc.).

As stated by OED, except as the vehicles of information, this meaning of communication (transmitting physical objects) is today rare and will here be ignored.

It follows, that if we look at the meaning of the terms information and communication they are closely related, and we should therefore expect information science and communication studies to be synonyms or near-synonyms. This also often seems to be the case. There are many indications that information science is about communication and uses this term as a synonym. Shannon's (1948) paper, known as a founding paper for information theory, was titled *A Mathematical Theory of Communication*. The field of scientific and scholarly communication is, despite the name, more related to information science than to communication studies (Fjordback Søndergaard, Andersen and Hjørland (2003) is an example). The final example is the most important one. White (2009, 59) considered literature searching and reading as a form of communication: "Communication with the literature", this means, that, among other core fields of information science, information retrieval and bibliometrics are here interpreted as communication studies (focusing on documents).

However, organizationally these two fields are separated. In *Web of Science*, for example, there is one field with one group of journals termed "information science & library science" and another field termed "communication". Information science and communication studies tend to have separate journals, conferences, university departments etc.

Borgman and Rice (1992) examined by means of bibliometric methods whether the disciplines of information science and communication were converging in the period 1977 to 1987. They found that the cross-disciplinary citing between the two fields was mainly carried out by a few journals, few journals were mainly responsible, and overall found very little convergence between these disciplines. One should consider, however, that neither information science nor communication studies (or other fields such as information systems) are coherent disciplines but consist of distinct subsets of journals with little mutual overlapping (e.g., bibliometrics, information retrieval and knowledge organization in information science and media studies, management/organizational studies, and interpersonal communication in communication studies). It would be more informative if such substructures were considered. Some subfields (such as, for example, human-computer communication, medical informatics, and internet studies) may be more connected to both information science and to communication studies, compared to, for example, interpersonal communication. So, we should not assume that categories as those used in *Web of Science* cover integrated fields of study.

The understanding of (1) information science (2) communication studies and (3) the interaction between (1) and (2) should be studied from the perspective of the history and theory of those fields, as described, for example, by Hjørland (2018b; 2018c) about information science, Dervin and Reinhard (2017) and Meyen (2015) about communication studies, and Ruben (2017) about relations between information and communication. Dervin (1977) argued for a paradigm shift in information science based on communication studies.

4.0 The term "information" in information studies

There are useful overviews of conceptions of information in information science (e.g., Belkin (1975; 1978) and Ingwersen and Järvelin (2005), but in this section the point of departure is the development of the field, considering alternatives to the information concepts. In librarianship, the focus of practice and study was originally books,[33] whereas documentation from the late 1800s developed a broader focus, which additionally included journal articles among other kinds of items and their representations in bibliographies and later in bibliographical databases. For this purpose, they introduced the generic term "document".[34] The idea was that this term should be used for whichever kind of object could serve to document something, and thus the kinds of object of interest to classify, index and represent in repositories or databases (as well as in libraries, archives, museums etc.) This term became also subsequently influential in librarianship as the generic term with the same meaning. Thus, core issues in librarianship and documentation can be said to be about the selection, description, indexing, clas-

sification and searching of *documents*. Many people still think this is the most fruitful and best considered concept for this purpose (e.g., Frohmann)2004), Hjørland (2000), Ørom (2007),[34] Spang-Hanssen (2001)), but from about the 1950s the term information largely began to supplant the term document in this field.

Shapiro (1995, 384; italics in original) described the use of the term "information" in this field prior to the 1950s:

> *Information desk* appeared as an alternate to *reference desk* by 1891. *Information bureau* was in use by 1909 to denote an office where reference service was provided; in 1924 the *Association of Special Libraries and Information Bureaux* (*Aslib*) was founded in Britain. In the *Aslib Proceedings* for 1932, *information work* was introduced to describe reference assistance.
> Use of *information* as an equivalent of *reference* began to give way, under the influence of developments in computing, to more sophisticated usage. In 1950, Calvin N. Mooers introduced *information retrieval*. This term became extremely popular in the 1950s and 1960s.

What is the reason for the supplanting of "document" with "information" in librarianship and documentation? Does the last term contain more kinds of objects of interest to these fields? Or are there other well considered arguments for it? The immediate impression may be that the answer is "yes" (information is broader), but this impression is challenged by the broad concept of document developed in the documentation movement as well as by other considerations. An influential definition by Suzanne Briet (1951, 7; here cited from Buckland 1991a, 47) is: "A document is 'any concrete or symbolic indication, preserved or recorded, for reconstructing or for proving a phenomenon, whether physical or mental'".

Perhaps some people would argue that a fact such as "Napoleon was born in 1769" is information, but not a document, or that a sentence in a document is information, but not itself a document. Concerning the first objection, facts can only be represented in databases or information systems if they are, what Buckland (1991b) called "information as thing", but information as thing (or informative objects) corresponds to the broad understanding of document developed by the documentation movement and also advocated by Buckland himself.[36] Concerning the second objection, a short subsection of a document has been termed a microdocument (e.g., by Ranganathan 1963, 29), and in information retrieval the term "passage retrieval" is often used (cf., Kaszkiel and Zobel 1997). Although there have been many arguments against supplanting the term "document" with "information", there has as far as we know only been one serious defense for the term information ("information retrieval" rather than "document retrieval"), but this defense is not convicting (see Endnote 37).

But why, then, did the term information supplant the term document? The two most important reasons may be (1) the influence of Shannon's so-called "information theory"[38] (Shannon (1948); Shannon and Weaver (1949)) and (2) the higher status and prestige associated with the term 'information', including the prestige obtained by confusing document management with issues related to more technological issues, or confusing information specialists with IT specialists (1 and 2 are not unrelated).

Concerning Shannon's theory, it should be said that it is a theory which is very important in computer science, and which in the 1950s and 1960s was believed by many to be able to contribute in a very deep and important way to solve problems in librarianship and documentation, and to which most people trying to do serious research in these fields saw no real alternatives.[39] And the fields of librarianship and documentation were (sometimes) renamed "information storage and retrieval" (see Hjørland 2015); later the label "information science" became influential. The term "information science" has been traced back to Farradane (1955) concerning the education of information scientists, a term introduced by Farradane (1953) which he considered a synonym for documentalists.[40] Fields such as library science, the science of bibliography, scientific information and documentation were predecessors of information science, as pointed out by Kline (2004, 19):

> Called bibliography, documentation, and scientific information during the first five decades of the twentieth century, the field became known as information science in the early 1960s.

One of the events that marks the entry of the term information in the fields of documentation is the change in name of the *American Documentation Institute* (founded in 1937) in 1968 to the *American Society for Information Science*. Another set of events is about establishing LIS as a field, which is associated with schools of LIS, which became established in the latter half of the 1960s when schools of librarianship began to add the term "information science" to their names. The first school to do this was the one at the University of Pittsburgh in 1964. More schools followed during the 1970s and 1980s and, by the end of the 1990s, almost all the library schools in the USA had added the element "information science" to their name, and a similar development took place in many other parts of the world.

The connection between information and information science was suggested in *Oxford English Dictionary* (OED) by Proffitt (2010), who noted:

> In quick succession [after information processing, information retrieval, information storage (all three dated from 1950)] came terms relating to the academic study of the phenomenon, appearing in a neatly logical sequence: first the idea (information theory, 1950), next its budding adherents (information scientist, 1953), then the established field of study (information science, 1955).

This is one indication of how the term information became so influential in librarianship and documentation that it became the name for the field. Information theory is not just a theory of a phenomenon (information) that was known before the theory was formulated. Information theory provided its own definition of information. *Oxford English Dictionary*, information, sense 2c:

> As a mathematically defined quantity divorced from any concept of news or meaning [...]; *spec.* one which represents the degree of choice exercised in the selection or formation of one particular symbol, message, etc., out of a number of possible ones, and which is defined logarithmically in terms of the statistical probabilities of occurrence of the symbol or the elements of the message. The latter sense (introduced by Shannon, quot. 1948[2], though foreshadowed earlier) is that used in information theory, where information is usually regarded as synonymous with entropy (ENTROPY *n.* 3b).

This theory allows us to measure how many bits are in a given file or are being transmitted in a wire or a wireless connection.[41] It is simply a necessary theory for computer science. But although there have been expectations that this theory and its corresponding definition of information would also be fruitful for librarianship/documentation/information science, this turned out to be a false hope. A clear explanation of why Shannon's information theory does not work for the field of documentation is given by Spang-Hanssen (2001), who wrote:

> I shall only mention a few points to show the limitation of this measure [Shannon's amount of information] to our conception of information.
>
> – In Shannon's sense, the amount of information is proportional to the length of the message (in a given code). This obviously does not apply to the utilization of literature as information. Among other things, an abstract may be as informative as the complete paper.
> – Shannon's amount of information presupposes a measure of the uncertainty on behalf of the receiver. By the utilization of literature as information no measurable uncertainty can be defined generally.
> – Shannon's amount of information applies to some explicit coding and cannot in the case of normal writing (or speech) account for semantic relations that are not shown by similarities of expression. E.g., the synonyms 'serials' and 'periodicals' would be treated as different messages (or parts of messages) having different 'amounts of information'.

An important thing to consider is whether this terminological shift from document to information was motivated by change in subject matter, if they had any substantial background, or if they were merely reflecting terminological shifts related to popular trends or fads? Spang-Hanssen wrote: "The word information – and combinations like information retrieval, information center – have definitely contributed to raise the public opinion of library and documentation work, which is generally held to be a little dull, dusty and distant from what is actually going on in society". He also wrote that he had no moral objections to such use but warned about conceptual confusion. However, in retrospect the use of information rather than document has caused so much confusion in the field that we must question Spang-Hanssen's view about the moral legacy of using the term. Academic fields must aim at terminological and theoretical clarity, and bad terminological hygiene cannot be justified by such political reasons.

The case is, as pointed out by Furner (2004), we do not really need a separate concept of information to do information studies, because we already have perfectly good concepts of sign, data, meaning, relevance, and so on, that allow us to get the job done. All the problems we need to consider in information studies can be dealt with without any need for a concept of information.[42]

There is another serious problem with the concept of information in information studies. People educated in this field are sometimes called "information specialists". But what is an information specialist a specialist in? If we recall Buckland's statement (1991a, 50) "We conclude that *we are unable to say confidently of anything that it could not be information*", we face the problem that information specialists are experts in anything, the logical implication being that they are experts in nothing.

Although the introduction of the term information in librarianship and documentation was, as we saw, primarily caused by the influence of Shannon's theory, and although Wersig (2003, 213) called the period between 1948 and the 1970s "The Shannon and Weaver phase", thus indicating that this period ended in the 1970s, the term information continued to be used, but its meaning changed according to the theoretical orientation (see Hjørland 2018b and 2018c

about theoretical developments in LIS). There is rising interest for social, semiotic and constructivist approaches in the field.[43] It should be mentioned, however, that, among others, Robinson and Bawden (2013, 136) still seek inspiration in the natural sciences development of information theories.[44]

Burgin (2010, vii-viii) wrote about the use of the concept information in what he terms information science (which might better be considered a range of different information sciences):

> Looking into information science, we encounter a peculiar situation. On the one hand, it has a lot of theories, a diversity of results, and even a proclaimed success. Scientists have created a bulk of information theories: Shannon's statistical information theory, semantic information theory, dynamic information theory, qualitative information theory, Marschak's economical information theory, utility information theory, Fisher's statistical information theory, algorithmic information theory and so on. Researchers study information ecology (cf., for example, (Davenport [and Prusak] 1997) and information economics (cf., for example, (Marschak 1959; 1974; Arrow 1984; Godin 2008)), created information algebra (cf., for example, (Burgin 1997b; Kohlas 2003)), information geometry (cf., for example, (Amari and Nagaoka 2000)), information logic (van Rijsbergen 1986; 1989; Demri and Orlowska 1999), information calculus (van Rijsbergen and Lalmas 1996), physics of information (cf., for example, (Stonier 1990; Siegfried 2000; Pattee 2006)), and philosophy of information (cf., for example, (Herold 2004)), but still do not know what information is. Each year, dozens of books and thousands of papers are published on problems of information. On the other hand, as it is written in the introduction to the authoritative book "Information Policy and Scientific Research" [Manten and Timman 1983], 'Our main problem is that we do not really know what information is'.

Burgin's conclusion seems thus to confirm the one we reached by considering LIS: There is no agreement of what "information" means or about its role in theoretical issues in the field, and there are even suggestions that the term should rather be substituted with "document". The introduction of the term information has led to an unnecessary duplication of synonyms (materials selection becomes information selection, document retrieval becomes information retrieval etc. etc.).

4.01 The term information in knowledge organization

Hjørland (2012) examined the relation between four phrases: knowledge organization (KO), information architecture (IA), information organization (IO) and organization of information (OI). Should they be considered synonyms, or do they represent 2, 3 or 4 different concepts?

- Knowledge organization (KO) is well established and used as name for an established field of research with the *International Society for Knowledge Organization* (ISKO) and its publications, including the journal *Knowledge Organization*, as core actors in this field. ISKO got its name in 1989, and Bliss's (1929) book *The Organization of Knowledge and the System of the Sciences* may also be considered a milestone in establishing the field. The tendency to relate library classifications to classification of knowledge (e.g., the liberal arts curriculum in the Middle Ages: the trivium (grammar, rhetoric, and logic) and the quadrivium (arithmetic, geometry, music, and astronomy) goes, however, far back in the history of libraries (see Miksa (1994)).[45]
- Information architecture (IA) is a term of a more recent origin (its history of is described by Resmini and Rosati (2011)), first used about computer architecture in 1964, but today Evernden and Evernden (2003, 1; italics in original) claim: "*Information architecture is a foundation discipline describing the theory, principles, guidelines, standards conventions and factors for managing information as a resource*". The field has different perspectives, among others an emphasis on design and architecture, but Rosenfeld and Morville (1998) was a very popular and influential book, which, for a period, made IA almost synonymous with the design of webpages. This book is very much in the information science/knowledge organization tradition (with, for example, thesauri, controlled vocabularies, and metadata, but with emphasis on web-applications). Despite the overlapping topic, IA is relatively unconnected to KO (with different lists of highly cited authors and papers), and as said it claims to be an independent discipline. A question is, however, if there is a basis of two different disciplines (KO and IA) IA may have a focus in which KO has a weaker profile. But if KO as a discipline aims at developing systems and processes for many different contexts (and if IA aims at the broad definition cited above) then the basis for two different disciplines seems to disappear. In other words, at

the theoretical level, KO and IA should be considered synonymous terms. See also Jacob and Loehrlein (2009).

- Information organization (IO) and organization of information (OI) are two phrases that are more interdisciplinarily used and thus less sharply defined. Hudon (2021, 11) showed that these terms (OI and IO) are now by far the most used terms for knowledge organization in master's programs accredited by the American Library Association, seemingly being used synonymously, with OI being the most applied phrase. Texts such as Svenonius (2000) and Taylor and Joudrey (2017) are clearly in the field of LIS/KO but have respectively preferred the terms *organization of information* and *information organization* in the title, while Rowley and Hartley (2008) wanted to guard themselves and therefore used both "knowledge organization" and "information" in their title. However, if we look at the collected number of disciplines, the most cited authors, papers, and journals using the terms IO and OI are more cited in other fields compared to KO, for example in cognitive psychology and management science. (This does not indicate, however, that IO and OI have the same meaning in, e.g., KO and cognitive psychology).

Our conclusion is that KO, IO and OI are used as synonyms within library and information science, but that IO and OI represent other concepts in relation to, for example, cognitive psychology and management science. Again, the use of IO and OI seems not to be based on scholarly arguments but rather on issues about popularity.

If KO and OI (for example) are synonyms, which of the terms should be preferred? The field's declining interest in information theory and its growing interest in "knowledge sciences" such as epistemology, the sociology of knowledge and the social history of knowledge is one argument for preferring the term KO. Another argument is that KO is historically and organizationally the term that is best established (the tendency often to change names for scholarly fields should be considered bad terminological hygiene if they are not well motivated).[46]

5.0 Some selected compounds and phrases

Compounds and phrases containing the word information are numerous, and their use and meanings contribute to provide a deeper understanding of the term information. For example, why is *information retrieval* used as name for a field of study (rather than, for example, document retrieval)? Is the field known as *knowledge organization* the same as what is designated *information organization*? Below a selection of the most important are presented and discussed (in alphabetical order). No attempt has been made to provide full coverage of all compounds, but to present the ones deemed to be most important.

- *Information architecture*. The name of a field closely related to knowledge organization, with emphasis on designing webpages (see further Section 4.1 in the present article).
- *Information explosion* OED: "a rapid increase in the amount of information available, (now) esp. as a result of the increased use, availability, and sophistication of information technology". Spang-Hanssen (2001) pointed out that this term is problematic by ignoring if anybody is being informed and found it "can in the first place be termed only the publication explosion".[47]
- *Information management* is a polysemic term. It can mean both a subfield of LIS, and an independent field or part of the field of management. As a LIS-term it may refer to the way information resources are managed, and thus be synonymous with knowledge organization (with classification, indexing, document description etc. being termed information management, as is the case with the journal *Information Processing and Management*, formerly called *Information Storage and Retrieval*), but it may also refer to the way organizations manage their information resources (and how information technology may support such activities), and this meaning is by far the most used. Information management also has an unclear relation to the term "knowledge management" (See further in Detlor (2017) and Bouthillier and Shearer (2002)).
- *Information need* is a concept that is much used in LIS and IR. It is dominated by a psychological rather than by a subject-oriented perspective,[48] which is problematic.[49] If, for example, a student (or a researcher) writes a paper, his teacher (or a peer reviewer) may find, based on their subject knowledge, that the student or researcher needs to consult some sources. The idea that information professionals primarily need psychological knowledge about users to help them is therefore a serious fallacy. It is typical that researchers in the psychological school speak of information needs in very abstract ways, omitting, for example, to consider their own information needs or those of their colleagues, which quickly would reveal the subject-oriented and epistemological dimension of the concept.
- *Information organization* and *organization of information* are two terms commonly used as synonyms with knowledge organization (see Section 4.1 in the present article).
- *Information overload* OED: "exposure to or provision of too much information; a problematic situation or state

of mental stress arising from this (cf. information fatigue n.)". This term is problematic in considering information as some physical quantity (documents). If information is understood as knowledge (corresponding to Buckland's first category cited above) one would not speak of "knowledge overload" in the same way. What is meant by information overload is not that somebody is too well informed, but that the process of being well-informed is too time-consuming and costly because the user must consider too many fragmented claims with insufficient tools to select the most relevant ones.[50]

- *Information processing* OED: "the processing of information (by a machine or by an organism) so as to yield new or more useful information; frequently attributive; cf. data processing n.". This term seems unclear in distinguishing between data processing, message processing,[51] sign processing[52] (including word processing and text processing), and knowledge processing. (The term is part of the title of the journal *Information Processing and Management*). Probably the main use of the term concerns algorithms working on data processing (see also Slamecka (2018)).
- *Information retrieval* (IR) was coined by Mooers (1950, 1951). OED defines it: "the tracing and recovery of information using reference materials, esp. the recovery of information stored in a computer system". The term is extremely widely used and is considered a core field in information science, although research has mainly migrated to computer science (and provides the basis for search engines, among other systems). As discussed in the present article it should be considered a misnomer for "document retrieval". Hjørland (2021) found that mainstream IR research is based on statistical distributions of words or n-grams in documents, collections of documents and queries. Alternatively, he suggested a top-down perspective based on concepts and conceptions and the philosophy of science connected to the field of knowledge organization. Compared to the broader term "information searching", IR is today mainly used about statistical based search techniques.
- *Information science* is a term that was first used by Farradane (1955) It is further described in the present encyclopedia in article *Library and Information Science (LIS)* (Hjørland 2018b; 2018c). There are a number of disciplines and fields engaged with the term information, and many use it as a core term for their definitions. Different fields, such as information science, information systems science, information architecture etc., have such vague definitions that it is impossible to differentiate them based on such definitions. They are often strongly overlapping, and their differentiation seems less caused by subject matter and more by origins in different contexts (e.g., librarianship, management and computer science).
- *Information scientist* was first used by Farradane (1953) as another term for documentalist. It is sometimes used as a synonym for information professional, although the last term includes people who are not working as researchers.
- *Information searching* is a term with a different connotation compared to IR and information seeking. It is about selecting sources to be searched, subject access points chosen and search strategies to be used. Professional principles for searching databases, including "literature searching" and "document searching". are better termed "information searching" than "information retrieval" or "information seeking". The terminology is loose, and this is also often called information seeking, but there is a need for another term. Example of texts are Higgins et al. (2019, chapter 4) and Markey (2019). Document searching includes the use of bibliographical references, see Citation Indexing and Indexes (Araújo, Castanha and Hjørland 2021).
- *Information seeking* is a term mostly used about descriptive (as opposed to normative) approaches in the way people search for information, e.g., when they or one of their relatives get a disease. It is much connected to psychological issues and researchers' assumptions about psychological factors influencing why and how people seek information. It is a very popular subfield of LIS. The journal *Information Research: An International Electronic Journal* is mostly about this topic and *Looking for Information* (Case and Given 2016) is a standard in this field.
- *Information storage and retrieval* (IS&R) is a phrase that seems mainly to have been replaced by the term information science. The journal *Information Processing & Management* was founded in 1963 as *Information Storage and Retrieval* but changed its name to the current one in 1976. See further in Hjørland (2015).
- *Information system*. A term used by a multitude of rather different things (see Stewart, Cotton and Adya (2017), and endnote 53). Libraries, databases, knowledge organization systems and information retrieval systems are, in a way, kinds of information systems, and logically this term should therefore be considered part of LIS (as it sometimes is, e.g., in (Buckland 1991a)). Information systems is however the name for another field with its own journals (e.g., *Information Systems Research*), associations (e.g., *Association for Information Systems, https://aisnet.org/*), conferences, university departments, etc.[54] As a discipline, information systems is related to management ("management information system", MIS). See further in Haigh (2001).
- *Information technology* (IT) is defined by OED: "The branch of technology concerned with the dissemination, processing, and storage of information, esp. by means of

computers." [55] Haigh (2011, 432-3) explained that the term changed meaning. Its first use (Leavitt and Whisler (1958)) intended to promote a technocratic vision for the future of business management but was revived in policy and economic circles in the 1970s with a new meaning:

- Information technology now described the expected convergence of the computing, media, and telecommunications industries (and their technologies), understood within the broader context of a wave of enthusiasm for the computer revolution, post-industrial society, information society (Webster 1995), and other fashionable expressions of the belief that new electronic technologies were bringing a profound rupture with the past. As it spread broadly during the 1980s, IT increasingly lost its association with communications (and, alas, any vestigial connection to the idea of anybody actually being informed of anything) to become a new and more pretentious way of saying "computer." The final step in this process is the recent surge in references to "information and communication technologies" or ICTs, a coinage that makes sense only if one assumes that a technology can inform without communicating.

– Despite great overlap with computer science and other fields, there seems to be a tendency for information technology to establish itself with societies, journals, educational programs etc. There are, for example, many bachelor programs in IT.[56]
– *Information theory* goes according to OED back to 1948 and is closely associated with Shannon's (1948) theory, although Spang-Hanssen (2001), among others, argued that this was a misnomer.[57] Other meanings refer to the various theories used in information science (e.g., Wersig 2003), which would be logical if it the term information science itself were not also a misnomer. See also Hofkirchner (1999), Hjørland (2002b).

6.0 Conclusion

In developing scholarly fields, such as library and information science with knowledge organization, one should consider the different theoretical orientations and work on the further development of the most fruitful perspective. In this process, all the terms used should be considered and evaluated from the perspective of providing theoretical clarity, theoretical coherence, etc. One should not start with a concept or theory because it has appeal or prestige or is popular. Of course, the usefulness of such theories should also be considered, and it is important in scholarship that negative results are also well considered and documented. A term should not be considered in isolation, but in relation to other terms (e.g., data, sign and knowledge) in the given domain. The conclusion is therefore that the way forward is first to consider the relative merits and disadvantages of different meta-theoretical positions such as information theory and semiotics, and second to develop the field from such a well-considered perspective.

The term information seems to be a very clear example of the theory of semantic holism associated with Kuhn's (1962) theory of scientific paradigms, which suggests that each paradigm is associated with its own concept of information, and the other way round: that each concept of information, more or less, corresponds to a specific paradigm. We have seen how ancient hylomorphism understood information as bringing everything in the world in-form, which was replaced by empiricism's view that the world came to in-form the senses of individuals, implying a very different concept of information. Shannon's view is of information as a mathematically defined quantity divorced from any concept of news or meaning, which is highly fruitful in computer science, but not in LIS. The cognitive view of information as something that changes the knowledge structures of individuals and semiotic, social, and cultural understandings of information such as Goguen (1979): an interpretation of a configuration of signs for which members of some social group are accountable. The lesson to be learned is that information can only be understood as a part of its theoretical context, and the search for a fruitful understanding must consider the fruitfulness of the paradigms and theories of which it forms part.

Acknowledgements

Thanks to Daniel Martínez-Ávila for serving as editor for this article, and to two anonymous reviewers for constructive suggestions, which have improved it.

Endnotes

1. Professor in Information Studies, Jonathan Furner, wrote (2021, 1; and on his homepage, retrieved September 1, 2021), "a tricky one. Maybe best to save it for later". Haigh (2011, 433): "In the history of information technology, as in other areas defined through reference to "information," definitions are problematic and categories unstable. As [... Robert A] Fairthorne (1965, 10) observed more than forty years ago, the word's appeal is often as "a linguistic convenience that saves you the trouble of thinking about what you are talking about".
2. An anonymous peer-reviewer wrote: "Not sure I agree with Burgin (2010, vii) "Thus, there are messages without information" nor do I find his definition helpful. There's hardly any point in sending a message without information unless one is playing which is not what this article is about".

3. Qvortrup also writes that the major reason for the difficulties in defining it is caused by the attempts since the 1940's to define it as an objective thing. Qvortrup (1993, 3; italics in original) wrote: "What then *is* the problem regarding the concept of information? What makes it so tricky? The basic problem seems to be that since the 1940's it has aimed at becoming a natural science concept, an objective thing, a substance, a 'Ding an sich'. But every time it has been close to becoming a decent, objective concept it has been caught up by its fate that information is a concept which implies a human subject. Information isn't just information in itself; it only becomes information when it is information to somebody, i.e., as a mental construction".
4. Furner's (2021, 1) first answer to the question: "What is information studies?" was: "'Information studies' is just the name that some people use to refer to the area of inquiry that they're interested in. That might sound unhelpful, but the problem is that it has proven very difficult to find a definition of information studies that everyone in information studies agrees to. It's easier, and perhaps more accurate, to say that information studies is what the community of people, who say they do information studies, do". However, the problem may be worse than this answer reveals. It may also be impossible to find agreements about what psychology is or even what chemistry is. But even if there is not agreement about the definition of terms like psychology and chemistry, there seems to be a much higher consensus both internal in these fields and external (e.g., among people hiring professionals). There is one issue in which I disagree with Furner. He says that it is up to the reader (a new student?) to decide if s/he prefers one or another definition of information. But surely, new students should expect the people responsible for managing their education, that these people are able to argue for such matters and are working towards the solutions that they find best (and so should the people who are expected to recruit information professionals). However, it should be said that Furner does say something about what he consider important by stating: "The most important variants [of the meaning of the term information] are probably the ones in which it is understood that meaning is not literally contained in any given statement, but is at least partially determined by the context in which the statement is made – a context that encompasses the mental state of both speaker and hearer".
5. Semantic holism is an implication of Thomas Kuhn's (1962) philosophy of science. Kuhn exemplified changes in the meaning of terms in his way:
   – Paradigm one: Ptolemaic astronomers might learn the concepts [star] and [planet] by having the Sun, Moon, and Mars pointed out as instances of the concept [planet] and some fixed stars as instances of the concept [star].
   – Paradigm two: Copernicans might learn the words "star", "planet", and "satellites" by having Mars and Jupiter pointed out as instances of the concept [planet], the Moon as an instance of the concept [satellite], and the Sun and some fixed stars as instances of the concept [star].

   Thus, the terms "star" and "planet" gained a new meaning and astronomy gained a new classification of celestial bodies.
6. Peters (1988, 10; italics in original) wrote: "Words have many and conflicting senses, sometimes outright opposing ones (*cleave*: to divide, to join). The senses of words hang together less like logical propositions than like inhabitants of a house or city. Not logic but life, in Wittgenstein's great insight, governs the structure and coherence of discourse. The meaning of a given 'language game' comes from the 'forms of life' with which it is 'interwove'. [...] The story of *information* is just such a one of dissolving and migration forms of life".
7. Scerri (2019, 3-4) explains that these four elements were believed to consist of microscopic components with different shapes, which explained the various properties of the elements. These components correspond to Plato's four kinds of solids: earth made up of cubes, water by icosahedron, fire of tetrahedra and air by octahedra). (Earth was considered to consist of cubes because it is difficult to move earth; water consists of elements with a smoother shape, fire is painful to touch because it consists of sharp particles, and air was given the only remaining solid). Scerri (2019, 3) wrote: "Although the notion that elements are made up of Platonic solids is regarded as incorrect from a modern point of view, it is the origin of the very fruitful notion that macroscopic properties of substances are governed by the structures of the microscopic components of which they're comprised". It should be added that the four solids originally were the only ones considered possible from a mathematical point of view. The later discovery of a fifth solid, the dodecahedron let to the proposal that a fifth element: "ether".
8 Burgin (2010, 2) wrote: "During the Renaissance the word "to inform" was synonymous to the word "to instruct." Later its meaning extended essentially and it became one of the most important technical and scientific terms. One of the most common ways to define information is to describe it as one or more statements or facts that are received by people and that have some form of worth to the recipient (Losee, 1997)".
9. Peters (1988, 16): "In the context of the state information becomes a thing, a noun, a reified stuff separa-

ble from processes of informing. It shows up in various shapes and sizes-as news, research data. intelligence, evidence, intellectual property – in different bureaucratic contexts". Nunberg (2021, 497) has a somewhat different explanation, that associated this new conception of information with the press, writing: "The association of information with the press and other printed documents shaped the way it was perceived, as a self-sufficient substance detached from its source and independent of any individual consciousness. This is one of the important ways in which information differs from knowledge, which always requires a knowing subject – an individual, a collectivity, or at the limit a text, which serves as a proxy for its author. We speak of 'human knowledge,' for example, but we don't ordinarily speak of 'human information' – we don't identify information in terms of its possessors. 'Medical knowledge' refers to the body of knowledge possessed by members of the medical community, whereas 'medical information' refers simply to information about medical matters, wherever it happens to reside. As the sociologist Alvin Gouldner observed, information doesn't require a specific knower: it is "a product that can be found in a cardfile, a book, a library, a colleague, or some other 'storage bank.'"". (Nunberg did not provide a bibliographic reference to this Gouldner quote – and unfortunate this lack of references is generally the case with the whole book in which this chapter was published - the references are neither available at the books homepage – as expected from the description of a link in the introduction). It seems also problematic that it does not discuss Peters (1988). Gouldner's quote has been identified as Gouldner 1970, p. 492-3, and its exact expression is this: "Knowing as the pursuit of information, however, conceives of the resultant knowledge as depersonalized; as a product that can be found in a card file, a book, a library, a colleague, or some other "storage bank". Such knowledge does not have to be recallable by a specific knower and, indeed, does not have to be in the mind of any person; all that need be known about it is its "location". Knowledge as information, then, is the attribute of a culture rather than of a person; its meaning, pursuit, and consequence are all depersonalized. Knowledge as awareness, however, is quite another matter, for it has no existence apart from the persons that pursue and express it. Awareness is an attribute of persons, even though it is influenced by the location of these persons in specific cultures or in parts of a social structure. A culture may assist or hinder in attaining awareness, but a culture as such cannot be aware").

10. On *The Great Chain of Being* see Kleineberg (2017, Section 2.1) https://www.isko.org/cyclo/integrative_levels#2.1
11. Machlup (1983, 642) wrote: "The noun 'information' has essentially two traditional meanings: (1) 'the action of informing; the action of telling or [the] fact of being told of something,' and (2) 'that of which one is appraised or told; intelligence, news'." Any meanings other than (1) the *telling of something* or (2) *that which is being told* are either analogies and metaphors or concoctions resulting from the condoned appropriation of a word for something that had not been meant by earlier users".
12. About misinformation see Fox (1983).
13. Floridi (2019, Section 2.2): "A highly structured, perfectly organised message contains a lower degree of entropy or randomness, less information in Shannon sense, and hence it causes a smaller data deficit, which can be close to zero (remember the raven). By contrast, the higher the potential randomness of the symbols in the alphabet, the more bits of information can be produced by the device. Entropy assumes its maximum value in the extreme case of uniform distribution, which is to say that a glass of water with a cube of ice contains less entropy than the glass of water once the cube has melted, and a biased coin has less entropy than a fair coin. In thermodynamics, we know that the greater the entropy, the less available the energy. This means that high entropy corresponds to high energy deficit, but so does entropy in MTC: higher values of H correspond to higher quantities of data deficit". See also Appendix: 1948 (Shannon 1948).
14. Shannon's theory inspired the Danish writer Tor Nørretranders (1998) to introduce the term *exformation*, which means explicitly discarded information. Nørretranders' argument was that a message, which has been selected and synthetized is more valuable than all the unfiltered information. But this concept and idea is mainly valid within the framework of information as a thing compared to the framework of information as knowledge.
15. Bremer and Cohnitz (2004, 237-8) wrote: "The idea of amount of information is – at least for the beginning – given up, but may have been not that central in the first place. That some sentence is more informative than another can in many cases be seen by its logical complexity and the corresponding set of consequences within some theory and using some logic. A logarithmic measure is too far off from the available and practically usable knowledge in situations of communication.".
16. Buckland (1991b, 356): "To include objects and events, as well as data and documents, as species of information is to adopt a broader concept than is common. How-

ever, if we are to define information in terms of the potential for the process of informing, i.e., as evidence, there would seem no adequate ground for restricting what is included to processed data and documents as some would prefer, e.g., by defining information as "Data processed and assembled into a meaningful form". (Meadows, [Gordon and Singleton] 1984, 105). There are two difficulties with such a restricted definition: Firstly, it leaves unanswered the question of what to call other informative things, such as fossils, footprints, and screams of terror. Secondly, it adds the additional question of how much processing and/or assembling is needed for data to be called information. In addition to these two specific difficulties there is the more general criterion that, all things being equal, a simpler solution is to be preferred to a more complicated one. Therefore, we retain our simpler view of "information-as-thing" as being tantamount to physical evidence: "Whatever thing one might learn from" (Orna and Pettit 1980, 3).

17. Porat (1977 vol 1, 2; emphasis in original) "Information is data that have been organized and communicated. The information *activity* includes all the resources consumed in producing, processing and distributing information goods and services".
18. Machlup (1962 vol. 1, 228) defines this new sector of the economy as ".... a group of establishments firms. institutions. organizations. and departments, or teams within them, but also in some instances, individuals and households-that produce knowledge, information services or information goods, either for their own use or for use by others" (cited from Cooper 1983, 12).
19. The precise sentence and paragraph from Bateson (1972, 453) is: "I suggest that Kant's statement can be modified to say that there is an infinite number of differences around and within the piece of chalk. There are differences between the chalk and the rest of the universe, between the chalk and the sun or the moon. And within the piece of chalk, there is for every molecule an infinite number of differences between its location and the locations in which it might have been. Of this infinitude, we select a very limited number, which become information. In fact, what we mean by information – the elementary unit of information – is a difference which makes a difference, and it is able to make a difference because the neural pathways along which it travels and is continually transformed are themselves provided with energy. The pathways are ready to be triggered. We may even say that the question is already implicit in them". Remark that Qvortrup (1993) contains a rather detailed presentation of Bateson's writings in relation to his definition of information.
20. Qvortrup (1993, 4) considered two different definitions: (1), Bateson's: a difference which makes a difference "i.e., a difference in reality which causes a mental difference" (2) "*a difference which finds a difference*, i.e., a conceptual difference which finds or which is confirmed (or triggered) by something in the outer world". It is difficult, however, to understand why Bateson's definition is not equivalent with the second one suggested by Qvortrup. In both cases something in the outer world triggers something in the organism or system being informed, and that system must be constructed so that it is only triggered by that particular thing.
21. McKinney and Yoos (2010, A2-A3) concluded their overview of theoretic approaches to the concept of information: "This historical review suggests that as philosophical outlooks have changed, information has changed (Völz 1996). Currently, philosophy has no universal theory of the structure of the world; therefore, a universal theory of information should not be expected (Horz 1996). Absent a unifying view of philosophy, present day scientific domains make a variety of assumptions about ontology and epistemology that lead to multiple perspectives on information. For example, in various domains information is order (De Vree 1996), a sign (Stamper 1985), a truth condition (Israel and Perry 1990), a property of the universe, on objective commodity intrinsic to objects (Dretske 1981; Stonier 1996), or simply the combination of a sign, a thing, and a person (Borgmann 1999). This surfeit of definitions, and the lack of a unifying philosophical outlook, has produced a preparadigmatic state of flux".
22. Marchionini (2010, 8) wrote about wisdom in relation to the DIKW-pyramid: "The term 'wisdom' is sometimes included in this data-information-knowledge hierarchy; however, I reserve it for something distinctly human and singular that is of a different phenomenon class than the data-information-knowledge hierarchy of increasingly ordered, contextualized, and expansive energy. Wisdom is an inherently human characteristic that entails intuition, trust, empathy, patience, humility, and personal and social balance. Whether wisdom is due to experience or to chemical balances in the body, it is not dependent on information at hand or at mind but perhaps by what we are able to do with and without information. Hall (2010) examines the meanings that scholars have given to wisdom over the years. Early philosophy related wisdom to experience rather than intelligence. Twentieth century work began to associate wisdom with aging and the ability to recognize life-important rather than intellectually important situations and to balance intelligence and emotion".

23. [Alternative terms for *designed* could here be *pre-encoded*, *developed* and *constructed*; in biology, for example, it is not an intentional act, but the result of development due to principles of evolution].
24. Chaitin (1999, 106) wrote: "The conventional view is that matter is primary, and that information, if it exists, emerges from the matter. But what if information is primary and matter is the secondary phenomenon! After all, the same information can have many different material representations in biology, in physics, and in psychology: DNA, RNA; DVD's, videotapes; long-term memory, short-term memory, nerve impulses, hormones. The material representation is irrelevant, what counts is the information itself. The same software can run on many machines. INFORMATION is a really revolutionary new kind of concept, and recognition of this fact is one of the milestones of this age".
25. Bawden and Robinson (2020, 2-3): "The increasing acceptance of information as a physical quantity is indicated by the importance given to it in an article on the next hundred years in physics by Nobel laureate Frank Wilczek [2016], who predicts that fundamental action principles, and thus the laws of physics, will be interpreted as statements about information and its transformation". However, what Wilczek (2016, 38) claimed was not that information is the ultimate concept that replace matter and energy but that computers will play an important role in physical inquiry: "Increasingly, the development of algorithms will become a central focus of theoretical physics. Concepts and equations that computers can run with will be powerfully leveraged; concepts and equations that cannot be turned into algorithms will be regarded as deficient". Wilczek's article does not provide arguments that contradict the understanding of the relation between matter, energy and information described by Karpatschof (2000) as presented in Section 3.1. (Wilczek also claimed that "Modern microelectronics and computing offer attractive possibilities for accessing that information. By appropriate transformations, we can encode it in our existing channels in a sort of synesthesia. By vastly expanding the human sensorium, we will open the doors of perception and see the world as it really is". However, this view seems to neglect the insight that observations (by both humans and computers) are always dependent on the subjectivity of the observer. The subjectivity of computers is connected to the purpose for which they are made and the assumptions of their designers and programmers. To imagine a future in which information directly (or unmediated) informs about reality is a kind of naïve empiricism).
26. Bates (2017, 2059) wrote: "Though this sequence [DIKW] may feel intuitively right, it is difficult to take it from its popular meaning and develop it into something sufficiently refined to be useful for research". Buckland (1991b, 354) wrote: "It is wise not to assume any firm distinction between data, document, and text". Adriaans (2010, 49) wrote: "In a lot of popular writings one can find the idea that in terms of information theory there are three layers one can distinguish: data, information, and knowledge. A small survey I did among colleagues a couple of years ago revealed that almost none of them took these distinctions to be very clear or valuable". Tuomi (1999) argued that information is not processed data, and knowledge not processed information, on the contrary, data emerges only after we have information, and that information emerges only after we already have knowledge. This insight has important implications for developing information systems and managing information.
27. Buckland (1991b, 351): "The term 'information' is also used attributively for objects, such as data and documents, that are referred to as 'information' because they are regarded as being informative, as 'having the quality of imparting knowledge or communicating information; instructive.' (Oxford English Dictionary, 1989 vol. 7, 946)". Buckland 1991b, 352 Figure 1 *information-as-thing* is used as a synonym for *data* and *document*.
28. Atkin (2013, Section 1.1) wrote: "Peirce's idea that a sign does not signify in all respects and has some particular signifying element is perhaps best made clear with an example. Consider, for instance, a molehill in my lawn taken as a sign of moles. Not every characteristic of the molehill plays a part in signifying the presence of moles. The color of the molehill plays a secondary role since it will vary according to the soil from which it is composed. Similarly, the sizes of molehills vary according to the size of the mole that makes them, so again, this feature is not primary in the molehill's ability to signify. What is central here is the causal connection that exists between the type of mound in my lawn and moles: since moles make molehills, molehills signify moles. Consequently, primary to the molehill's ability to signify the mole is the brute physical connection between it and a mole. This is the sign-vehicle of the sign. For Peirce, then, it is only some element of a sign that enables it to signify its object, and when speaking of the signifying element of the sign, or rather, the sign-vehicle, it is this qualified sign that he means".
29. Definition from v. 1897_- C.P. 2-228 - Division of signs, here cited from Robert Marty. 76 Definitions of the Sign by C. S. Peirce https://arisbe.sitehost.iu.edu/rsources/76DEFS/76defs.HTM
30. Raber and Budd (2003) consider the relation between information science and semiotics. Liebenau and Back-

house (1990) is an introduction to information written from the semiotic perspective. Rieger (1996) is an argument for a semiotic perspective rather than traditional cognitive perspectives on information processing.

31. Beynon-Davies (2011a, 2011b) also considered the sign concept and suggested a new vocabulary (2011a, 316): "Forma relates to the physical world and stands for the objective nature of information. Informa relates to the psychological world and stands for the subjective nature of information. Finally, performa relates to the social world and represents the inter-subjective nature of information".
32. For an important discussion of the relation between knowledge and human interests, see Barnes (1977). About the problem on the neutrality of knowledge, see Hjørland (2020). As a point of departure for a pragmatic theory of knowledge for the information sciences, Hjørland and Albrechtsen (1995, 407) used some principles suggested by Sarvimäki (1988, 58-9; italics in original):
    1. Man is primarily an actor, living and acting in a biophysical, a socio-cultural and a subjective world.
    2. Living and acting in the three worlds constitutes the *a priori* of human knowledge.
    3. Since living and acting constitutes the *a priori* of knowledge, knowledge is constructed in such a way that an application of well-constructed knowledge will directly or indirectly serve living and acting.
    4. When knowledge becomes part of an acting system, it functions as an internal action determinant.
    5. There is a continuous interaction between knowledge and action so that knowledge is created in and through action and so that experiences that the actor acquires through action influences subsequent action.
    6. Value-knowledge, factual knowledge, and procedural knowledge are three types of knowledge connected to three types of internal action determinants. Having value-knowledge means knowing what fulfills the criteria of good values. Having factual knowledge means having true beliefs about the three worlds in which one is living. Having procedural knowledge means knowing how to carry out a specific act or act sequence.
    7. Knowledge can be unarticulated or articulated. Unarticulated knowledge is, for instance, tacit knowledge, familiarity, knowledge by acquaintance. Knowledge can be articulated in everyday language, science and art.
33. The ordinary meaning of the term book is a paper-medium consisting of written pages or images, composed of many pages, which are bound together and protected by a cover. The word has several other meanings, however. In book history and literary studies, the meaning is broader, including handwritten paper scrolls, e-books, and sound books. Rose (2017) describes the history of the book (and thus the concept "book") very broadly to encompass: "all kinds of documents, including manuscripts, periodicals, newspapers, and ephemera".
34. Buckland (1991b, 354): "A printed book is a document. A page of hand-writing is a document. A diagram is a document. A map is a document. If a map is a document, why should not a three-dimensional contour map also be a document. Why should not a globe also be considered a document since it is, after all, a physical description of something. Early models of locomotives were made for informational not recreational purposes (Minns, 1973, 5). If a globe, a model of the earth, is a document, why should one not also consider a model of a locomotive or of a ship to be a document? The model is an informative representation of the original. The original locomotive or ship, or even a life-size replica, would be even more informative than the model. 'The few manuscript remains concerning the three ships that brought the first settlers to Virginia have none of the power to *represent* that experience that the reconstructed ships have.' (Washburn, 1964). But by now we are rather a long way from customary notions of what a document is".
35. Ørom (2007, 70-71) concluded his article: "Recent development in the field of library and information science (domain analysis and related views to different extents) criticizes the dominant theories and research traditions in the field for reductionism, for a narrow understanding of the object, for the exclusion – or simplification – of the semiotic aspect of documents, and for the exclusion of social and cultural perspectives. This critique can be related to the conceptual history of information. The meaning (and consequently also the) context of the concept has narrowed down to a neutral, almost de-contextualized entity. Domain analysis and related views aim in the opposite direction, i.e., the direction of the contextually extended and complex concept of the 'document'. In other words the discourses on 'document' have changed from more particular and restricted meanings to a multi-dimensional and integrated theoretical discourse. Document typology and knowledge organization are well-developed (sub)disciplines in actual library and information science, and these (sub)disciplines have their basic foundation in Otlet's 'documentation'. The 'document' is intimately related to organized collections of documents, and the 'document' is understood in a historical, sociological, and systematic context by Paul Otlet, the founding father of 'la documentation'".

36. Spang-Hanssen (2001) wrote: "Moreover, these terms ["information science" and "information retrieval"] are not seldom confused with a more or less obscure use of the word information to mean something factual or real as opposed to representations of such facts; what is found written in documents – or what is said in a lecture – are according to this view only disguises or at best surrogates of facts. This more or less vague conception seems to be the basis of the distinction sometimes made between "fact retrieval" and "document retrieval". This distinction I find philosophically unbased; we here touch upon the fundamental problem of the meaning of meaning and of the nature of signs and symbols. What is more essential to us, this distinction seems unfortunate in actual documentation work. There will, admittedly, be cases in which a document or information center is set up with the exclusive function of providing information concerning physical data, or statistical figures, or exchange rates of currencies, or stock market prices. But even in such cases, it applies that neither the person who requests such information nor the person who delivers it should ignore the reliability of data and forget about the general setting in which the data is acquired. Information about some physical property of a material is actually incomplete without information about the precision of the data and about the conditions under which these data were obtained. Moreover, various investigations of a property have often led to different results that cannot be compared and evaluated apart from information about their background. An empirical fact always has a history and a perhaps not too certain future. This history and future can be known only through information from particular documents, i.e., by document retrieval. The so-called fact retrieval centers seem to me to be just information centers that keep their information sources – i.e., their documents – exclusively to themselves".
37. van Rijsbergen and Lalmas (1996, 386) wrote: "In the early days of Information Retrieval (van Rijsbergen, 1979), people used to qualify their statements about information retrieval (IR) by saying that really they were working on document retrieval. It was denied strenuously that information was being retrieved. As Lancaster (1968) wrote, 'An information retrieval system does not inform (i.e., change the knowledge of) the user on the subject of his inquiry. It merely informs on the existence (or non-existence) and whereabouts of documents relating to his request.' The situation has changed. We believe that the purpose of an information retrieval system is to provide information about a request and that a request is a representation of an information need that an IR system attempts to satisfy. Hence, a fundamental problem is how to compute the information contained in one object (e.g., a document) about another (e.g., a query). Thus, if a user states a query then it behoves the IR system to find the objects that contain information about that query". One objection to van Rijsbergen and Lalmas's view concerns the last sentence: "it behoves the IR system to find the objects...". But information as objects may, as we have said, be called documents (We use informative objects and documents as synonyms). Another objection to Rijsbergen and Lalmas's view is that it is limited by an individualistic understanding. As Kwon (2016, ii) wrote: "If 'information' is a central concept for library and information science, then 'questions' are fundamental, for information 'informs' relative to the question. But research focusing on questions as a central theoretical concept has been stymied by the paradox of the question, which observes that in order to ask one must know enough to know what one does not know [...]. This dissertation proposes that this paradox results from the limitations of the cognitive approach to questions as indications of individual information need, and that the paradox can be resolved by reframing questions as social epistemological tools of inquiry within knowledge domains". An implication of Kwon's view is, that information needs are not primarily private, they are relative to open and closed research questions considered from the perspective of knowledge domains (see further Hjørland (2021)). A third objection, closely related to the second, but perhaps clearer, is that our "information needs" often cannot be answered directly. We may need, for example, information about how best to cure cancer, but to evaluate the answers we need information about different approaches and methodologies in cancer research, and in the process of learning about this, our need may change rather significantly, and for example turn out to be whether Bayesian statistics can solve some of the problems associated with evidence-based methods. Of course, such a transformation of information needs cannot be done by lay people, they must trust experts. But if there are disagreements among experts the lay person risk to get a wrong answer. To conclude, Rijsbergen and Lalmas's view that an information retrieval system aims at directly inform the users, is problematic. It informs about the whereabouts of documents relating to query, and these documents inform about results of research, including theories, approaches and controversies. Therefore: "Information need" is not a psychological concept, it is not something that psychological investigations can illuminate, it is something which depends on subject knowledge about the domain of the query, and which on this basis is attributed to individuals. Example: a teacher of English language may say about a stu-

dent that he needs information about English grammar (whether or not the student himself think he does).

38. Spang-Hanssen (2001) wrote: "Information theory is an unfortunate – but since 20 years well established [1950]–designation for the statistical theory of communication developed in the tele-engineering [i.e., telecommunications engineering] field by Nyquist, Shannon a.o. This field is not concerned with documents, and not even primarily concerned with the content or meaning of documents or other symbolic representations, but concentrates on the efficient transmission of signals, which may – or may not – convey meaning. It is therefore unfortunate to confuse the term information theory with information as occurring in information science and information retrieval".
39. Bawden (2016) wrote: "As for theories of information, Shannon's Mathematical Theory of Communication was pretty much the only game in town. Its limitations in application to the concerns of the less technical end of the information sciences were well recognized, but there was interest in how it might be applied more widely".
40. This means that any talk of information since before 1955 is a neologism. For example, Lilley and Trice (1989) has the title *A History of Information Science, 1945-1985*. It covers, as we can see, information science in the ten years (1945-1955) before the term information science was used for the first time (and its use for the first time in 1955 is not the same as saying information science was established as a field as that time), so it covers more than 10 years of the history of the field before that field was established.
41. Qvortrup (1993, 5; italics in original) pointed out, however, that there is an internal conflict in Shannon's theory of whether information is an objective or a subjective thing: "Thus, actually two conflicting metaphors are being used: The well-known metaphor of information as a quantity, like water in in the water pipe, is a work, but so is a second metaphor, that of information as a choice – a choice made by an information provider, and a forced choice made by an information receiver. Actually, the second metaphor implies that the information sent isn't necessarily equal to the information received, because any choice implies a comparison with a list of possibilities, i.e. a list of possible meanings. Here, meaning is involved, thus spoiling the idea of information as a pure 'Ding an sich'. Thus, much of the confusion regarding the concept of information seems to be related to the basic confusion of metaphors in Shannon's theory: is information an autonomous quantity, or is information always *per se* information to an observer? Actually, I don't think that Shannon himself chose one of the two definitions. Logically speaking, his theory implied information as a subjective phenomenon. But this had so wide-ranging epistemological impacts that Shannon didn't seem to fully realize this logical fact. Consequently, he continued to use metaphors about information as if it were an objective substance. This is the basic, inherent contradiction in Shannon's information theory". (In note 2 Qvortrup discusses whether Shannon considered his theory to be a theory of information or about something else).
42. An anonymous reviewer wrote: "Furner's idea that we do not need a concept of information for LIS is quoted uncritically ("the case is ..."). If the author really believes that Furner meant this literally (I think he was writing provocatively) and supports this view, then it negates much of the rest of this article". In scholarly research we must keep to what has been written, not what we believe the author's intentions are. I think Furner meant what he wrote, but that he is reluctant to make this totally clear and to take the consequences in his later writings (and I am not able to see how supporting this view negates other claims made in this article). In spite of Furner's view in the 2004 paper, that information studies do not need the concept information, he wrote in Furner (2014): "In this paper, I have wanted to draw attention to the fact that, conversely [to the claim in the 2004 paper], there are several scholarly communities other than information studies that do require a separate concept of information, but that those communities have good reason to look to information studies for help. Any approach to conceptualizing information that downplays the contributions of LIS – i.e., information without information studies – is needlessly impoverished, not least on account of the range of ontological possibilities that it misses". This view seems somewhat paradoxical: how can information studies develop knowledge of a concept which plays no part in the development of knowledge of the field? Also, according to the principle of semantic holism, should we not expect each field to develop their own concepts (imbedded in the theories of the field?). Furner's claim would be more convincing if it exemplified what findings in information studies can enrich a specific problem in another field.
43. Concerning constructivist approaches in the LIS see Bosancic and Matijevic (2020).
44. Robinson and Bawden (2013, 136): "conversely, many in the library/information sciences are concerned about the application of the term 'information' to objective, meaningless patterns. Le Coadic (1987), Cole (1994), Hjørland (2007; 2008; 2011), and Ma (2012), for example, argue in various ways against any equating of the idea of information as an objective and measurable 'thing' to the kind of information of interest in li-

brary and information science; this kind of information, such commentators argue, is subjective in nature, having meaning for a person in a particular context, and cannot be reduced to a single objective, still less quantifiable, definition. However, this perhaps overlooks some recent trends in the physical and biological sciences themselves: not merely the increased focus on information noted above, but a tendency towards conceptualisations involving non-linearity, systems thinking, complexity, and reflexivity. All these tend to make current scientific thinking a more amenable source of analogy for the library/information sciences, than heretofore".

45. Brookes (1980, 127) wrote: "... my colleagues in librarianship also use the term knowledge in an objective way. They speak and write about 'the organization of knowledge', though when I looked into their works I found that they discussed only ways of classifying documents. But documents and knowledge are not identical entities". Brookes is right that knowledge organization is very much about the classification of documents, but there are two reasons that justify the term knowledge organization: (1) As already written the organization of documents has traditionally been based on systems for classification of knowledge, and so it should, according to Bliss (1933, 37), who argued: "To make the [bibliographic] classification conform to the scientific and educational organization of knowledge is to make it the more practical". (2) Knowledge organization systems (KOS), for example classification systems and thesauri, are classification of concepts, which may be considered units of knowledge, and the construction of KOS is a core activity in the field of knowledge organization.
46. Webber (2003) shows how many courses in England shift titles from "information science" to "information management" simply because the word science is not popular among the students that one wishes to attract.
47. Spang-Hanssen (2001): "information explosion, disregards the informee(s). What is called the information explosion can in the first place be termed only the publication explosion, or even the paper explosion: the number of printed pages in professional journals and books is increasing at a rate that can be described by an exponential function, like explosions. This, however, does not form an explosion of information, unless the number of printed pages is proportional to the amount of information resulting from the production and the distribution of these pages. In other words, when using the expression "the information explosion" we tacitly assume that professional papers contain information to a constant degree, regardless of their number, and regardless of their being utilized by informee(s)". Although Spang-Hanssen's analysis seems important, one may object that researchers such as Derek Solla Price's influential writings (e.g., 1961; 1963) not only considered published works, but also the growth in the number of scientists, universities etc. Still, however, the term is mainly used about the growth pattern of documents.
48. Just two examples of the prominent position of information need in the literature of information science are the special issue of *Information Processing and Management* in 2020 (Borlund and Ruthven 2020) and the third edition of a book on assessing information needs (Nicholas and Herman 2009). An important inspiration for the psychological approach to information needs was Taylor (1968).
49. There has not been much criticism of the theoretical assumptions behind the concept "information need". Wersig (1973) proposed that information need is ultimately determined by the requirements posed by work tasks; Shinebourne (1980) suggested that emphasis should be put on providing better bibliographic aids for the users rather than to use the time studying the users. Hjørland (2002a, 263) suggested that the domain analytic and socio-cognitive view consider information needs to be caused by social and cultural factors. Information needs may be compared with educational needs. Both kinds of needs develop to master some problems about which some knowledge has already been produced. Savolainen (2017, 11-12) wrote: "However, there are HIB [human information behaviour] models in which shift in HIB research dating back to the 1990s. Since that time, the factors triggering and driving information seeking, as well as the processes of identifying, selecting and using information have increasingly been approached as context-sensitive phenomena. From this perspective, need for information or information need is no longer posited as a primary impetus to information seeking because the ways in which people interpret their information needs are dependent on contextual factors such as the urgency of task at hand".
50. Pfister (2021, 17) wrote: "Critics of digital culture frequently highlight the ongoing crisis of "information overload" as the cause of multiplying epistemic problems. According to these critics, the abundance of available data makes it much more difficult to decide what to believe about political dramas, scientific controversies, consumer purchases, and other human obsessions. The characterization of information overload in a digital context is increasingly creative: it has been variously referred to as information glut, infobesity, infoxication, and data smog. The fear of digital information abundance has been as creatively explored, with its draw-

backs including information anxiety, information pollution, paralysis by analysis, continuous partial attention, attention deficit disorder, and multimultimultitasking, in addition to the proliferation of con artists and computational propaganda. At the same time, information is positioned as a marvelous antidote for that which ails us: with more data, we might finally be able to meaningfully assess political dramas, scientific controversies, and consumer purchases, in other words the very human obsessions that the abundance of data complicated.".

51. Kirschenmann (1970, 2). Cybernetics deals with "the reception, transmission and processing of messages in complex, dynamic systems, whether they be technological systems, animals, or social orders". (Here cited from Vucinich (2002, 16)).
52. In relation to sign processing, compare this quote (Watt 1998): "In what might be called the standard version of semiotic theory, which in most essentials we owe to the American polymath Charles S. Peirce, our knowledge of the external world, in fact all thinking of any kind, is composed of chains and skeins of linked representations or signifiers ('signs' for short). The world enters our consciousness as highly processed sense-reports, which begin as representations (for instance, the electro-chemical signals into which our light-receptors transform the light striking the retina). So, the world is understood, to the extent that it is, via signs, many of which stand for still other signs, each bound to what it signifies by interpretive (re)appraisals, which take account of such things as general knowledge and immediate context".
53. *Encyclopedia of Library and Information Sciences* (McDonald and Levine-Clark 2017) contains the following articles carrying the word system or systems in the title: Association for Information Systems (AIS); Careers and Education in Information Systems; Clinical Decision-Support Systems; Collaborative Systems and Groupware; Collection Management Systems; Decision Support Systems; Document Information Systems; Ethical Issues in Information Systems; Geographic Information Systems (GIS); Information Retrieval Support Systems; Information Retrieval Systems; Information Systems; Information Systems Failure; Integrated Library Systems (ILS); Knowledge Organization System Standards; Networked Knowledge Organization Systems/Services (NKOS); Open Archival Information System (OAIS) Reference Model; Subject Cataloging Principles and Systems; Tanzania: Libraries, Archives, Museums and Information Systems and Unified Medical Language System® (UMLS®) Project.
54. Iivari (2015) examined the development of the field of information systems by studying highly cited papers in the field. Land (2015) provided information about the early history of the information systems discipline in the UK based on personal experiences. McCoy, Everard and Jones (2015) provided information about the information systems discipline by studying attitudes towards course content by faculty, recruiters and students.
55. Information technology is a term used both about computing and, more rarely, about analog or non-electronic information technologies preceding or contemporary with computing technologies (see Robertson, 2020, for one among many possible presentations of IT before computers). However, as the term originated in the 1950s its use about all previous technologies represents neologisms. Haigh (2011, 432) wrote: "Looking at its two constituent words would suggest that information technology should include everything from ancient clay tablets through scrolls and books to communication systems of all kinds, newspapers, street signs, libraries, encyclopedias, and any artifact used for educational purposes. And indeed one sometimes sees such expansive definitions in textbooks of library and information science. I pass no judgment on the inherent merit of such a definition in observing that outside this rather small community the phrase is almost never used in this way".
56. Wikipedia wrote: "A degree in computer science can be expected to concentrate on the scientific aspects of computing, while a degree in information technology can be expected to concentrate on the business and communication applications of computing. There is more emphasis on these two areas in the e-commerce, e-business and business information technology undergraduate courses. Specific names for the degrees vary across countries, and even universities within countries". https://en.wikipedia.org/wiki/Bachelor_of_Information_Technology (Visited September 10, 2021).
57. Burgin (2010, 4) wrote: "Shannon himself applied the word information only in a descriptive sense to the output of an information source, and he stays resolutely within the framework of telecommunications, using the title communication theory. His followers renamed the theory information theory, and now, as Hajek writes, it is too late to revert to the name given by Shannon. Moreover, Shannon's theory is a kind of information theory as communication is information exchange. As this theory is built on statistical considerations, it is called statistical information theory". (Burgin (2010) contains no bibliographic references to Hajek).

58. Burgin (2010, 9) wrote: "Rochester develops this definition through building a hierarchy in which data are transformed into information into knowledge into wisdom. Thus, information appears as an intermediate level leading from data to knowledge. Ignoring that an "*organized collection*" is not a sufficiently exact concept, it is possible to come to a conclusion that we have an appropriate definition of information. This definition and similar ones are used in a lot of monographs and textbooks on computer science. Disregarding slight differences, we may assume that this is the most popular definition of information. This gives an impression that we actually have a working concept. Many will say, 'If such a definition exists and people who are experts and information theory in computer science use it, then what's wrong with it? Why do we need something else?'" After this quoted text Burgin consider some examples for explaining why Rochester's definition is incoherent.
59. Goguen (1997, 6): "It seems worth contrasting the view of information and meaning suggested above with the representational theory of meaning that is standard in computer science and in the Anglo-American analytic tradition of philosophy with which it is closely allied. [...] By contrast, a representational theory of meaning claims that a meaningful configuration of signs *represents* something in the real world. In sophisticated representational theories, such as situation semantics [Barwise and Perry 1983], what is represented by (say) a given phrase in English can vary with the context where it is interpreted, and need not be a simple object, but can be a complex of interconnected relationships, that is, what they call a \situation. This is adequate for some purposes, but even the most sophisticated representational theory leaves out the work of interpretation and the social accountability that is required for interpretation".

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Appendix 1:
A sample of definitions of information (chronological)
(Including brief statements that are not definitions)

15th century
Burgin (20, 2): "Etymologically the term information is a noun formed from the verb 'to inform', which was borrowed in the 15th century from the Latin word 'informare', which means 'to give form to', 'to shape', or 'to form."

1946
The American statistician John Wilder Tukey is said to have coined "bit" (from *binary* and *digit*) in 1946, but he did not publish it (see Anscombe 2003, 294-5). This concept played an important role in Shannon's (1948) information theory.

1948 (Shannon 1948)
"We shall call H = − Σpi log pi the entropy of the set of probabilities p1..., pn... The quantity H has a number of interesting properties which further substantiate it as a reasonable measure of choice or information." This definition has been generalized by OED: Information: "2c. As a mathematically defined quantity divorced from any concept of news or meaning (see [Fischer 1925, 709; Hartley 1928, 540; Fisher 1935, 47; Wiener 1948, 76; Shannon 1948, 394); spec. one which represents the degree of choice exercised in the selection or formation of one particular symbol, message, etc., out of a number of possible ones, and which is defined logarithmically in terms of the statistical probabilities of occurrence of the symbol or the elements of the message".

1948 (Wiener 1948, 155)
"[I]nformation is information, not matter or energy."

1968 (Thompson 1968, 305)
This paper emphasis the primacy of structure for the concept of information. Information was understood as "that result from applying the processes of organization to the raw material of experience, much like steel is obtained from iron ore".

1970 (Nauta 1970)

"Information is news: what is known already is no information. So, something is information to the extent that it is unknown, unexpected, surprising, or improbable."

1972 (Bateson 1972, 453)

"[I]nformation ... is a difference which makes a difference."

1974 (Parker 1974, 10)

"[I]nformation [...] is the pattern of organization of matter and energy."

1977 (Porat 1977 vol 1, 2; emphasis in original).

"Information is data that have been organized and communicated. The information *activity* includes all the resources consumed in producing, processing and distributing information goods and services."

1977 (Pratt 1977, 215)

"In-formation is the alteration of the Image which occurs when it receives a message. Information is thus an event; an event which occurs at some unique point in time and space, to some particular individual."

1978 (Belkin 1978, 81)

"[T]he *information* associated with a text is the generator's modified (by purpose, intent, knowledge of recipient's state of knowledge) conceptual structure which underlies the surface structure (e.g. language) of that text."

1979 (Farradane 1979, 17)

Information is "the physical surrogate of knowledge". (13: "many other attempted definitions of information [Debons and Cameron 1975, chapter 1 and 2] have been based on some assumed mental state of a recipient, to which properties have been ascribed such as 'novelty', 'an increment of knowledge', 'usefulness', 'interpretation of external stimuli', 'a fundamental property of matter and consciousness', 'increasing the state of knowledge of a recipient', 'resolving uncertainty', 'value in decision making', 'a structure or organization', 'transforming the structure of the recipient's image', or 'the generator's perceptual structure underlying the text'. Such definitions seem to be only expressions of ignorance of the nature of thought.)"

1980 (Brookes 1980, 131)

Brookes suggested a "fundamental equation" for the relationship between information and knowledge: K[S] + ΔI = K[S + ΔS] ([eq.]1), which states in its very general way that the knowledge structure K[S] is changed to the new modified structure K[S + ΔS] by the information ΔI, the ΔS indicating the effect of the modification".

Brookes commented (ibid.; italics in original): "The equation implies that if its entities were measurable, they would have to be measured in the same units, i.e. that information and *knowledge* are of the same kind. As defined here, *information* is a small bit of *knowledge* and so it would be correct to substitute ΔK for ΔI in eq. (1)".

When all comes to all, this definition says that information is a small bit of knowledge. Nothing about how "small" should be determined or defined. The equation was discussed and further developed by Bawden (2011).

1980 (Maturana and Varela 1980, 54)

"The notion of information refers to the observer's degree of uncertainty in his behaviour within a domain of alternatives defined by him, hence the notion of information only applies within his cognitive domain."

1981 (Dretske 1981, 44)

"Roughly speaking, information is that commodity capable of yielding knowledge, and what information a signal carries is what we can learn from it. If everything I say to you is false, then I have given you no information. At least I have given you no information of the kind I purported to be giving."

1983 (Machlup 1983, 642)

"Any meanings [of the term information] other than (1) the telling of something or (2) that which is being told are either analogies and metaphors or concoctions resulting from the condoned appropriation of a word for something that had not been meant by earlier users." (However, on p.658: "... the probability of confusion caused by metaphoric uses of the term is not intolerably great".)

1990 (Stonier 1990, 21)

"Information exists. It does not need to be perceived to exist. It does not need to be understood to exist. It requires no intelligence to interpret it [to exist]. It does not have to have meaning to exist. It exists."

1991 (Buckland 1991b, 356)

"Information as thing" is: "Whatever thing one might learn from".

(Also, 351: "Varieties of 'information as-thing' include data, text, documents, objects, and events. On this view 'information' includes but extends beyond communication. Whatever information storage and retrieval systems store and retrieve is necessarily 'information-as-thing'".

1992 (Ingwersen 1992, 33)

"One the one hand information being something which is the *result of a transformation of a generator's knowledge structures* (by intentionality, model of recipients' states of knowledge, and in the form of signs) and on the other hand being something which, *when perceived, affects and transforms the recipient's state of knowledge*."

(Here cited from Ingwersen and Järvelin 2005, 33; italics in original)

1992 (Kogut and Zander 1992, 382)

"By information, we mean knowledge which can be transmitted without loss of integrity once the syntactical rules required for deciphering it are known."

1994 (Moles, 1994)

"In modern semiotics the word information has two meanings. The first is the common language acceptance:

a message containing novelty. In the second, technical sense, it is the measurement of the quantity of novelty conveyed by a message..."

1996 (Cornelius 1996, 19)

"[I]nformation is properly seen not as an objective independent entity as part of a 'real world,' but [...] it is a human artefact, constructed and reconstructed within social situations. As in law, every bit of information is only information when understood within its own cultural packaging which allows us to interpret it." Further (20): "[T]here is no separate entity of information to discover independent of our practices. Up to the point that it is sought by a practitioner within a practice it is not information and cannot be interpreted. When a practice is seeking to impose meaning on something, that thing will already have come within the interpretive range of that practice and will already be at an early stage in a process of interpretation".

1996 (Rochester, 1996)

"Information is an organized collection of facts and data" (for a criticism of this definition see endnote 58).

1997 (Goguen 1997, 4)

"An item of information is an interpretation of a configuration of signs for which members of some social group are accountable."[58] Goguen (6-7) argues that information, as understood through his construction of the term, is situated, local, emergent, contingent, embodied, vague, and open.

1997 (Losee 1997, 256)

"Information is produced by all processes and it is the values of characteristics in the processes' output that are information."

2000 (Karpatschof 2000, 131-132)

"Information: The quality of a certain signal in relation to a certain release mechanism, the signal being a low-energy phenomenon fulfilling some release specifications."

2000 (Madden 2000, 348)

Information is "a stimulus originating in one system that affects the interpretation by another system of either the second system's relationship to the first or of the relationship the two systems share with a given environment...."

2004 (Madden 2004, 9)

Information is "a stimulus which expands or amends the World View of the informed".

2006 (Bates 2006, 1036)

Information 1: "The pattern of organization of matter and energy." [quoted from Edwin Parker (1974, 10)]

Information 2: "Some pattern of organization of matter and energy given meaning by a living being." (Bates' definitions were criticised in Hjørland 2007).

2010 (Burgin 2010, Section 2.2)

Section 2.2 has the title: "What Information Is: Information Ontology". It provides no definition of "information" but seven ontology principles (and some subprinciples). The two first are the most important ones and correspond almost to Karpatschof's (2000) definition:

- "Ontological Principle O1 (the Locality Principle). It is necessary to separate information in general from information (or a portion of information) for a system R. In other words, empirically, it is possible to speak only about information (or a portion of information) for a system."
- Ontological Principle O2 (the General Transformation Principle). In a broad sense, information for a system R is a capacity to cause changes in the system R. Thus, we may understand information in a broad sense as a capacity (ability or potency) of things, both material and abstract, to change other things. In what follows, information in a broad sense is also called general information.

2010 (Marchionini 2010, 55)

"Electronic media and the notion of information as experience, in turn, lead to new senses of information. One that seems to be emerging is information as an extension of ourselves – our conscious and unconscious footprints and connections in the cyber world that bridge the physical and mental worlds."

2018 (Janich 2018, Chapter 6: Consequences, 161)

"[T]he naturalization of information is nothing but a myth, one that stems from the investments of (logical empiricist) philosophy?" and ibid.: "No one should or can be taught that thinking of the world in her own language is irrelevant to (supposedly) language-independent necessities or experiences". "Naturalization refers here to the claim made by the natural sciences to the full (and finally exclusive) responsibility for the study and mastery of information. In short, naturalization aims to make information only (or at least primarily) an object of the natural sciences" (ibid., 3-4).

2019 (Floridi 2019)

"The General Definition of Information (GDI): σ is an instance of information, understood as semantic content, if and only if: (GDI.1) σ consists of one or more *data*; (GDI.2) the data in σ are *well-formed*; (GDI.3) the well-formed data in σ are *meaningful*." (This definition is developed in more of Floridi's publications. See Dinneen and Brauner (2015) for a positive evaluation and Adriaans (2010) for a critical analysis of this definition. See also "3.5 Floridi's philosophy of information" in Hjørland (2018c, 322-323).