What can information specialists do for science communication?

With cases from the Prior project

Volkmar Paul Engerer, University of Copenhagen, Royal School for Library and Information Science, Søndre Campus, build. 4, Njalsgade 76, 2300 Copenhagen S, Denmark; Tel. +45 3532-1341; e-mail volkmar.engerer@hum.ku.dk

Submitted 26 September, 2017, to JCOM – Journal of Science Communication.

Note: This is a draft and may not be circulated. I you refer to this paper, mention it correct and add that it is a preliminary draft. Thanks.

Draft

ABSTRACT: The paper investigates the role of information specialists in science communication and interdisciplinary research project environments. It identifies three scenarios in which information specialists meet researchers: researchers' cognitive knowledge building, research-related communicative activities in groups, and researchers as representatives of a whole, historic scientific community. These scenarios coincide with three approaches in information science: (1) library support; (2) system development; and (3) information science research into a discipline's traditions and practices. The paper provides the information science agenda for areas (2) and (3) and draws on personal experience from the author's work on the Prior project.

Keywords: Scholarly communication; Professionalism; Professional

Introduction

In this paper I will address how information science practice and information science practitioners best contribute to science communication in the digital age. I will put forward suggestions on how 'information specialists' (information scientists involved in practical project work, often librarians) professionally drive forward the development of systems for science communication and support digital collaboration in research projects in particular. Which professional competencies and skills do information science ‘generalists’ need when they cooperate with other researchers in interdisciplinary digital project environments? In other words, how does a meaningful and sustainable contribution by professional information scientists to digital science environments look?

Mentions of information science knowledge and the professional individuals who practice it—information scientists and information specialists—are abundant in the literature on research communication in the sciences as well as in the digital humanities. Widely acknowledged claims from the research literature that draw heavily on informational concepts include (only to name a few) ‘information overload’ in collaboration situations [Cummings and Kiesler, 2008, p. 113], ‘accessibility’ of scientific data, and ‘searchability’ of information through, for instance, a multitude of variable access points on scientific platforms [Borgman, 2007, p. 2; Elsayed, Madey, and Brezany, 2011, p. 270]. With regard to ‘digital information’ in science infrastructures the semantic distinction between mark-up and content has been thematised [Eggert, 2009, p. 75]. It is furthermore widely accepted that information is a collectively created and shared commodity in knowledge collaboration [Kimmerle, Cress, and Moskaliuk, 2012], where information systems link people on research platforms, researchers with information, and pieces of information with other pieces of information [Finholt, 2002, p. 79]. On a more general level, an essential connection between research-generated knowledge as the final goal of science and information as the mode of mediating and communicating it has been drawn or is tacitly presupposed in research communication research. This connection opened up not only the insight that information in collaboration systems is a kind of basic resource type on a bar with tools and knowledge [Bos et al., 2008, p. 68], it also helped to recognise the important role of tacit and presupposed knowledge in research collaboration and led to a consequential critique of the one-sided focus on explicit and textual information in digital research communication [Finholt, 2002, p. 96]. All in all, it seems that a theoretical understanding of science communication and collaboration is not complete without taking information science and knowledge organisation theory into account.

As has been seen, the ubiquity of information and knowledge concepts in the literature on science communication is widely attested, and much work in this field frequently appeals to the importance of information, information behaviour, and other related concepts in researchers’ learning, collaboration, and research practices. However, and in contrast to the numerous references to informational concepts and information specialists in research communication, scholars only occasionally address information science knowledge directly, and examples where information specialists systematically inform online science collaboration and research into it are harder to find.[1] This suggests that there might be a discrepancy between the widespread acceptance of information professionals’ relevance in science communication and the concrete disciplinary knowledge from this field that is actually used and set into action by them. This paper wants to fill this gap and

[1] Exceptions are, for example, Hockey, who emphasises the positive role of information specialists collaborating with researchers in digital humanities projects [but does not directly refer to information scientific sources, cf. Hockey, 2012, p. 87], and in particular, Christine Borgman, who is working intensively on exploring how information science concepts can be utilised in order to understand research communication and collaboration in digital scholarship [Borgman, 2007].

Draft

presents some methodological and theoretical insights from this field that can be useful in researching and practically developing scholarly collaboration from an information science perspective.

Online research communication and collaboration (and their scientific study) are relatively recent phenomena that are strongly connected with the rise of the networked personal computer and the World Wide Web [Tredinnick, 2007]. Seen from a more science-sociological perspective, it is thus not surprising that pronounced applied-practical and technological perspectives on research communication and collaboration characterise this field of research. Typical practical endeavours include research into taxonomies and types of research collaboration infrastructures [Bos et al., 2008], lists of success criteria for online collaboration [Olson et al., 2008], design of evaluation procedures for collaboration projects [Ramage, 2010], and issues related to, for example, coping with interdisciplinary digital communication and collaboration [Cummings and Kiesler, 2008]. The technological strand identifies grid-computing, big science, data mining, and dataspace [Elsayed et al., 2011; Finholt, 2002]; coding, standards, and mark-up techniques [Eggert, 2009; Flanders, 2012]; digital collaboration tools [Zaugg, West, Tateishi, and Randall, 2011]; and more factors that crucially determine modern digital research environments.

Though it is sometimes somewhat unclear how the results of these various strands of research connect with each other and what their consequences for a broader and more general picture of digital research communication and collaboration might be, we are facing a promising, exciting, and real interdisciplinary field of inquiry. Investigations in this area of research communication help us to better understand how researchers interact with technology, with other researchers (or the public), and with information—often all at the same time. My own proposals here concern the work of practically working information scientists in an interdisciplinary project setting, where the integration of information science knowledge into the development of scientific research communication and collaboration systems plays a crucial role.

The Prior project

The theoretical claims made in this paper are illustrated with cases from a current engagement in a research project with which I am presently affiliated. In the funded, Denmark-based research project 'The Primacy of Tense: A.N. Prior Now and Then' [Prior project group, 2017] researchers in the time logic of the New Zealand philosopher and logician Arthur Norman Prior work together with information and computer scientists affiliated with the Royal School of Library and Information Science at the University of Copenhagen. The information science group[2] in which I am participating has the task, among others, to develop the Danish Prior websites associated with the project, enhance communication and collaboration between Prior researchers on the project and

[2] The project group has reported on some of the information scientific background of the project elsewhere [Engerer, Roued-Cunliffe, Albretsen, and Hasle, 2017], and more visions for the development of the digital Prior resources along information scientific lines are in preparation [Engerer and Albretsen, in prep.].

Draft

worldwide and, last but not least, make Prior's unpublished manuscripts accessible in transcribed and digitised form. In 2017 the focus is on reworking and modernising the Danish Prior websites[3] and accelerating the output of transcribed manuscripts from the Prior Virtual Lab and making them more accessible on the Internet. In this paper I will draw extensively on my practical work in and experience from the project, in particular in the areas of interdisciplinary project collaboration between information scientists and logicians/philosophers on the project, the methodology of developing information tools for project participants, and problems connected with metadata, arising in particular from representing Prior's archival documents that are mostly handwritten letters and manuscripts in an appropriate way.

At the time of writing, the Prior website (Priorstudies, http://www.priorstudies.org/) offers a rudimentary taxonomy of Arthur Prior's archival material photographed at the Bodleian Library. As this taxonomy functions as the main entry for researchers to select the texts they intend to transcribe, the information scientist is facing the interesting challenge to represent these materials in a way that potential transcribers more or less immediately, without having the possibility to check the represented documents in full-text, can identify those manuscripts that will best fit their research interests and they therefore are willing to invest time and energy into by transcribing, commenting, and tagging. This strong alignment of metadata towards transcribers' domain-specific research interests has to be balanced against a more standardised, long-sighted, stable, and pragmatic metadata structure that both later and in subsequent phases of the document circle can function as a template for appropriate search surrogates of the final, transcribed full-text documents collected in an academic online database of Prior's handwritten products. I will use this problem setting in the paper to illustrate how important it is for information specialists to draw systematically both on information scientific expertise and the partner discipline's academic specialties in collaborating with 'domain specialist'—here logicians and philosophers.

Information specialists and scientific communication

How do information scientists link up with other researchers in a project environment—here the 'logical/philosophical part' of the Prior-project? To illuminate this rather complex liaison between information science 'generalists' and 'hard-core' domain researchers (logicians and time philosophers), I suggest a simple model consisting of a unidirectional transfer relationship in which information science and scientists are characterised by the academic 'donor' role, and the philosophical-logical research dimension as the academic 'receiver'. Information professionals who enact (i.e., bear/know, communicate, use, etc.) information science knowledge relate then to a complex receiver dimension of research activities in a certain domain other than information science (here in the field of logic and philosophy).

[3] Priorstudies http://www.priorstudies.org/, Prior Virtual Lab http://research.prior.aau.dk/,and 'Nachlass' http://nachlass.prior.aau.dk/).

The scientific ‘target’ dimension of time-logical and philosophical activities is threefold and comprises the following interrelated types. Most basically, the type ‘research’ stands for time-logical, discipline-based, scientific knowledge building on the cognitive level and touches one essential aspect of what we often call ‘learning’. These learning and knowledge building processes refer to the discipline’s research objects, in our case logical entities and concepts (for instance, a set or a proposition), logicians (for example, Arthur Prior), philosophical arguments and truths (for instance, the past cannot be altered), and so on; in this sense ‘research’ concerns knowledge of the first order.

The second type, ‘scientific communication’, refers to the communicative activities of time logicians and philosophers related to ‘research’ (first-order learning and knowledge building), but also includes all research-related ‘actions’ in a project, team, or group that typically are dealt with communicatively, hereunder practical research tasks such as project work, coordination, and joint knowledge building in publishing, meetings, on conferences, and in discussions.

Third, ‘scientific communication research’ is learning and knowledge building of the second order in the sense that it does not refer directly to logical-philosophical domain knowledge. Scientific communication research builds up knowledge with respect to the peculiarities and patterns of time-logical scientific communication in a whole science community and communicatively enacted first-order knowledge building in the research domain.

Typically, scientists appear in all three roles—and mostly at the same time. They are learning individuals who dig deeper into a difficult paper, they discuss the paper with their colleagues at the department, and they do this by drawing on their research identity as scholars in a specific discipline and on the background of their education, their discipline’s pool of methods and theories, conventions and norms, and their teachers and network with other researchers whom they respect and by whom they are respected. Although it is completely natural for scholars to live by their roles without reflection throughout their professional life, it is however important for the information scientist to identify one of the three scenarios as the ‘actual’, ‘relevant’, or situationally given and select the information science ‘competency mode’ in accordance to one of the three scenarios. Information science, personalised and instantiated by information professionals, connects then with the threefold scientific, logical-philosophical target dimension in three significant ways, as the following table demonstrates.

Insert Table 1 here (see end of text, following the References).

Cell 1 refers to information specialists’ individual support for logicians and philosophers in the project context. This includes typical librarian support tasks and library services such as verifying references, executing literature searches to cover researchers’ specific topics or research questions, accessing full text material for the project participants, and more. This area has traditionally received much attention in library and information science (LIS), for example, under the headings ‘information need’ [Calvert, 2015], ‘reference services’ [Barrionuevo, 2011], or ‘information literacy’ [Grassian and Kaplowitz, 2009; Lloyd, 2010; Owusu-Ansah, 2005; Stock and Stock, 2013]. I will therefore not touch on this topic in the paper.

Draft

Cell 2 demarcates the interface between the information professional and science communication in specific collaboration configurations such as formal/informal research groups, publishing teams, or projects. In more concrete terms, this cell implies activities of the information specialist that are focused on the scientific communication infrastructure for project (group/team) participants and not (or to a lesser degree) directed at problem solving or 'learning aids' in individual cases, as it was the case with library support in cell 1. Examples for initiatives that fall under this category are establishing a wiki for a joint book publication, enriching the project website with links to other time-logical and philosophical resources, working with the development of a designated communication tool (for example, the Prior Virtual Lab), and more. In this context the popular slogan of the 'self-reliant user/researcher' [Bawden, 2001, p. 224ff; Bruce, 1998, p. 41; Grassian and Kaplowitz, 2009, p. 270ff; Sinkinson and Lingold, 2010, p. 82] plays an important role and can be given a more precise interpretation, namely, as an attempt of information professionals engaged in individual library support to move on from cell 1 to 2 by enabling the user to solve research-related problems or questions 'by oneself' by resorting to tools implemented in a given scientific communication infrastructure, as indicated in cell 2.

Cell 3 applies to second-order knowledge relative to the logical-philosophical domain, as it concerns knowledge about information specialists' contribution to research and research communication infrastructure in the logical and philosophical disciplines. This 'meta knowledge' for information specialists is no longer restricted to or determined by the current collaboration form (group, team, or project), but refers to scientists as members of a community with its history, norms of quality standards, and good argumentation into which domain researchers are socialised by education, influential mentors in the domain, and different employments at academic institutions of the domain. How information specialists can access and utilise knowledge about entire research communities in their information science practice has been described by B. Hjørland in his domain analysis [Hjørland, 2002], which will be briefly discussed in one of the following sections. The present paper will therefore touch on aspects 2 and 3, communication infrastructure in collaborative environments and domain analysis/ontologies, but not on issues related to library support.

The establishment and interpretation of the dimensions and the resulting three cells are clearly based on tacit assumptions, ambitions, and personal convictions, which should be made explicit. As can be seen, I am committed to the pragmatic, technological, and development-oriented strand of research that generally characterises inquiries into research communication and collaboration. At the same time, I sympathise with a level of ambition that strives to take in information science knowledge as a whole network of scientific concepts into the realm of research communication study. This is at the present stage of my inquiry a too-ambitious goal, and moreover, leaves open the question on how the abstract knowledge system level of information science precisely connects with the concrete, individual level of information professionals. Regarding the latter, I prefer to think in partial knowledge systems from this domain, where the information specialist makes use of these knowledge systems by drawing on an entire, historically grown knowledge system of information science or partial systems thereof in problem-solving and development activities. I will interpret this individualised professional knowledge as the information specialist's professional competency: what makes it more natural for me to talk about real-world collaboration situations in the research project that I am engaged in, where real people and not only systems are involved. This last remark highlights another point, namely, my firm adherence to the information scientific principle that the user of a digital system—not the digital system itself—is the main goal of information scientific investigation. This principle underlies almost all modern information science research [Chowdhury, 2010; Hjørland, 1998; Lancaster, 2003] and, not quite unimportantly, helps information scientists maintain their professional identity by setting apart their work from computer scientists' research endeavours [Tredinnick, 2006; Tredinnick, 2007].

After these preliminaries, the remainder of the paper is structured as follows. The next two sections treat the role of information specialists in a concrete scientific communication context, the Prior project, starting with cell 2-activities (developing research communication infrastructure for the project) and progressing then to cell 3, where domain analysis and ontologies are discussed. The paper wraps up with some preliminary conclusions.

Information specialists developing communication: 'conventional' cell 2 approaches

The important question for the information specialist about which functionalities and features should be integrated into scientific communication systems is clearly not one that can be posed to the domain specialists—in our case the Prior researchers on the project. Philosophers and logicians furthering Prior's legacy who cooperate with the information science group are concerned with time logic, not with information systems, web interfaces, and database design (what again points at the importance and reality of the difference between first-order and second-order knowledge). The information specialist must therefore not only possess second-order information science knowledge and expertise in computer and database technology, but in order to connect information science with first-order logical and philosophical knowledge in a project environment, information scientists must also have an understanding of the bearers of this knowledge, their contexts they are working in, and their practices of communication and interaction with information. Therefore information specialists combine information science skills with a humanist view on system users and their professional and social backgrounds; they get 'acquainted' with the researchers' world in a professional and systematic way.

Seen from this perspective, the cooperation between Prior logicians and information scientists in one project environment offers the unique possibility of integrating project-specific practices of Prior researchers into the data and information structures, interfaces, and the makeup of the digital tools that have to be developed.

In achieving this goal, information specialists typically carry out two opposite moves. One has to do with establishing distance from the researchers, and another approaching them again, often simultaneously. Distancing involves observation 'from the outside' and obtaining facts about participants' research behaviour, in which information, in one way or another, is involved (seeking, collecting, organising, storing, retrieving, processing, … information). This perspective 'from the outside' carries within it itself the move of getting closer to the researcher, as the information

Draft

scientist’s observational data is the basis for his conceptions of the individualised research group’s information behaviours; even the involved researchers themselves often may not be aware of the patterns of their own practices. Information science implementation processes typically following the observation phase show a similar dialectic. Adjusting and customising research tools according to preceding observations is, on the one hand, a process of bringing digital tools in provisional alignment with research practices—in other words, approaching the researchers through digital systems. On the other hand, tests concerning how (if) the adjustments worked on the background of newly observed researcher behaviour lets the information specialist again take the distance perspective. So, the circle takes a new revolution in the ongoing development process.

Observation and acting according to observation correspond to establishing distance and getting close, respectively; they are linked together in a dialectic process that is not delimited by a ‘target’ value, but is itself the driving force of perpetual development. What is then meant with ‘practices of the Prior project group’ typically includes ethnographic-like features such as

- specific content and form of research questions Prior researchers put forward;
- types of research questions that tend to be approved as relevant by Prior researchers;
- preferred information resources of project participants, hereunder Prior’s handwritten manuscripts;
- motivation of Prior researchers to use these information resources;
- (re)search techniques approved by the project norms and executed in order to answer research questions that are considered relevant in the group;
- Terminology issues, i.e., techniques of developing and maintaining conventions of naming time-related logical objects specific for the project’s research, introducing new terminology, and adapting it to the terminological system given at a point of time.

An information structure that is directed at Prior researchers should reflect these practices. In the case of Prior’s Nachlass documents, this implies—perhaps trivially—that manuscript representations must as a principle (a) integrate terms used by Prior research, and (b) make sure that these terms denote concepts (objects) that are relevant for them. Indexing categories (sender, receiver, dating of letter, place, topics discussed, persons referred to, etc.) must therefore be grounded in the specific research questions of the project and by this offer relevant access points in expert search inquiries [Hjørland, 1998; Lancaster, 2003, p. 6]. This means that among other things, when constructing metadata for letters, not only standardised properties of the represented items such as sender, receiver, and dating have to be indexed—which is clearly a task that can be solved by the information professional alone without consulting domain researchers—but also other, more specific categories that can have a positive impact on current and future research in the project must be considered. Which indexing categories this should be is not a question that can be answered on the background of general indexing principles alone: the answer lies mainly in the acknowledged research practices of project participants themselves; it is thus an empirical, project-specific question rather than a principal question. Examples for directly project-related indexing categories could include writers’ references to their own and others’ manuscripts; the expression of doubts or critique with regard to their own or others’ work; an indication of the logical notation used; further

Draft

references to other letters; historical events, or other logicians or philosophers; and what the correspondence in question is about. This dimension of the representational structure must be solidly grounded in project research.

The principle of a project-aligned and document type-customised (here letters) metadata structure has consequences for an adequate search architecture as well. Search algorithms and retrieval technologies have to be adapted to the researcher's specific information needs and preferred search strategies. Prior research will approach retrieval systems differently both with respect to scientists from other domains and according to individual information needs: Is a researcher searching after a known item, specific information or a fact, information related to a problem or issue, executing an exploratory search, or just keeping up-to-date in the field? [Chowdhury, 2010, p. 201f]. Similar can be said about the presentation of search results that should not only meet the researchers' expectations, for example, in terms of quality and quantity of information in the result lists that the researcher is presented for, but also to generate new paths of research by confronting the searcher with perhaps unexpected search results [serendipity, comp. Batley, 2005, p. 137; King and Reinold, 2008, p. 12; Svenonius, 2000, p. 163].

This 'conventional', cell 2 approach connects the information professional in an interdisciplinary project setting with research activities of domain researchers, guides adequate indexing in terms of a defined user group's research behaviour, gives rise to advanced search facilities that build on solid knowledge about the user group's search norms, and promotes a mode of presenting search results that both make it easy for the enquirer spotting relevant information and discovering new information. The necessary professional knowledge is well-described in central fields of information science. On the representational side we find established disciplines such as indexing theory [Lancaster, 2003], metadata research [Hider, 2012], and the field of knowledge organisation with classification and thesauri as its central subareas [Broughton, 2006; Hjørland, 2003; Hjørland, 2008; Svenonius, 2000]. Fields of research studying the user-related aspects of information seeking are information retrieval [Baeza-Yates and Ribeiro-Neto, 2011; Chowdhury, 2010], information behaviour research, and theories of information seeking [Borlund, 2013; Case, 2012; Chowdhury, 2010; Ruthven and Kelly, 2011].

Draft

Creating knowledge for information specialists (cell 3): domain analysis and ontologies

Standard information science approaches to project collaboration build, as demonstrated above by the Prior information science team's strategy of distance and closeness, quite fundamentally on a correspondence between a research group's behaviour and the research infrastructure established for this group. The more general postulate of a close relationship between user features (linguistic, social, normative, situational, professional, etc.) and the structural makeup of the knowledge and information systems for these users is in information scientific terms described by the notion of the 'domain'. A domain from an information science view captures quite generally the dependency between first-order knowledge in a specific subject field (such as time logic and philosophy) and second-order knowledge and skills in managing and organising the information resources that are specific for that field, i.e., information systems that are associated with first-order logical and philosophical knowledge. Domain analysis takes the view that managing information resources and information systems (databases, websites, etc.) in a specific field of first-order knowledge demands knowledge of this field including its traditions, terminologies, norms and practices, and more [Bawden and Robinson, 2012; Hjørland, 2002].

Therefore, second-order knowledge is knowledge on information systems that is framed and informed by first-order knowledge about logics and philosophy. At the same time, domain analysis transcends the group/project level and focuses not on ad hoc collaborations but on the discipline as a whole—its traditions, norms, values, and methods. While the notion of a 'domain' predominantly captures the more static aspects of a discipline's identification practices and convictions, it also highlights the notion of a 'community' level of interacting researchers; however, beyond this difference in emphasis, the two terms seem to be used synonymously. Domain analysis creates, as suggested in cell 3, meta knowledge about how interdisciplinarily collaborating information professionals adjust general information science knowledge in terms of a scientific community's peculiarities. Birger Hjørland devised a crude but useful and pragmatic systematic for producing domain-specific meta knowledge necessary for information specialists in solving project-related, interdisciplinary tasks (Hjørland does not seem to differentiate between project-, group-specific, and community attributes in research communication). This methodology includes approaches such as subject gateways, specialist classifications and thesauri, disciplinary peculiars of indexing and retrieving practices, user studies, bibliometric studies, document and genre studies, terminological studies, historical studies, and more [Hjørland, 2002]. Domain analysis is a practical method and thus appears as a good starting point for the information science team to systematically collect knowledge about practices, modes of information seeking, language and communication conventions, and more that characterise the logical domain of which the Prior project researchers are part.

A further aspect of creating information science knowledge about a research community is addressed by the ontology concept that targets in peculiar the linguistic traits of a community's communicative practices, its community-specific language and terminology, and its semantics, that is, the first-order disciplinary knowledge that is encoded therein. The information scientific concept of an ontology relates the information specialist's traditional sphere of indexing terms, as described in conventional approaches, with the domain user's 'natural' search terminology. From this view, index terms are regarded as closely linked to (if not identical with) the professional vocabulary used by specialists in their domain. The move from traditional thesauri and classification schemes to ontologies of knowledge domains does not only mean the integration of semantic web principles into the description of data [Berners-Lee, Hendler, and Lassila, 2001]; it further demarcates the step from aligning knowledge organisation systems according to the needs of a specialised user group (cell 2) to encoding knowledge about the user group's linguistic behaviour both in cognitive research processes (cf. learning, 'thinking' and reasoning, terminologies, cell 1) and in scientific, research-related communication (language use; for example, speech acts, scientific arguments, cell 2) directly into the communication and information systems which the community members use. The move from barely developing a search terminology towards a controlled language for

Draft

knowledge representation implies to expand the lexical-terminological component towards a whole language with a built-in logic, a syntax, and inference rules, which makes it possible to derive information that is not explicitly contained in the descriptive terms themselves [Antoniou, Groth, van Harmelen, and Hoekstra, 2012, p. 4]. Ontology languages allow constructing sentence-like complex formulas that operate with linguistically-informed components such as subjects, verbs (relations), and objects. Knowledge is in this framework no longer just named, as is the case in traditional controlled vocabularies, but it can be described linguistically—compositionally built up in an iterative syntax and 'confirmed' or 'tested' via semantic models that relate the linguistic terms with real-world phenomena such as things, concepts, persons, or states of affairs.

Ontologies reflect a common understanding of a domain or a scientific communication community [Antoniou et al., 2012, p. 11] by expanding the restricted repertoire of thesaural relations between terms (broader/narrower term, related term, …) to an unrestricted range of semantic relationships realised and acknowledged in the domain idiom. Ontologies must therefore be constructed for each specific domain in order to reflect the language use practiced in the domain in question [Stuart, 2015]. Generally, an ontology models the expert user's view on information in his/her domain. More practically, the information scientist collects terms, their definitions, and mutual semantic relationships, and builds a formal vocabulary system that includes syntactical and inference rules. The advantages of ontologies for specialist users are among others improved possibilities for exploring data, 'semantic search' [King and Reinold, 2008, p. 22], enhanced serendipity, and optimised search results by using ontology-based search techniques including natural language processing [King and Reinold, 2008, p. 12].

Not unlike domain analysis, a complete methodology is linked to the creation of ontologies in specific domains, including steps such as systematically collecting the vocabulary, defining and classifying the vocabulary terms, and indicating the semantic relationships between the established classes [King and Reinold, 2008, ch. 3; Stuart, 2015]. Building an ontology is therefore in a way similar to doing a domain analysis as described in Hjørland [2002] though narrower in scope, as it focuses on first-order knowledge and models only the linguistic traits of the scientific community in question, both in terms of the lexicon and the communicative practices. Both methodologies, the domain analysis approach and the ontological, aim at transferring expert knowledge, often in tacit form, into the realm of explicit knowledge organisation, and both respect the linguistic form of this knowledge when modelling it in a knowledge system.

Conclusion

In this paper I tackled scientific communication from an information science angle. More specifically I asked what it takes for information specialists, often librarians, to collaborate professionally with other scientists in research projects. My perspective was a practical one, grounded in my experience from working together with time logicians and time philosophers under one project umbrella. I argued that information specialists meet 'domain specialists' (logicians and philosophers) in three roles, as cognising (reasoning, thinking) researching individuals, as

Draft

professionally acting and communicating researchers in a group/team (e.g., in a research project), and as members of a scientific community with collective traits, norms, conventions of acknowledged knowledge, a common history that defines the community's identity they are part of, and a pool of joint research traditions they can draw on (e.g., in controversial discussions).

These three roles define three professional spheres in which information specialists typically act: (a) the individual researcher specifically requires the information specialist's skills in library support; (b) researchers acting in research teams call for the information specialist's competencies in designing and developing a research infrastructure for the team (project group, etc.); and (c) we have the researcher who (mostly unconsciously) acts as a member of a community in a large, historic whole, in which he/she has been socialised into via his/her academic education. Here the information specialist's meta knowledge about how to access these traditionally grown community features and how they are realized in advanced documentary languages such as ontologies is on demand.

I believe it can be useful for information specialists to reflect over these researcher scenarios when entering interdisciplinary collaboration situations, for example, in scientific projects. It is important for good project collaboration that the information professional adapts his/her role to the researcher scenario in question in order to act appropriately: individual support, system knowledge, or understanding of the conventions the researcher is subject to are widely different skills that should be selected in correspondence with the respective researcher mode. Identifying the right scenario helps to select the right tools and communication strategies.

Furthermore, I hope that I could deliver a message to scientific project managers that information professionals can play an important role in scientific communication, ranging from individual researcher support and research system development to modelling research communities' language use and vocabulary directly in scientific communication systems. Knowledge of the three researcher roles, as developed in this paper, should inform project management decisions about which information science competencies should be drawn upon in the project: support librarians, humanistically educated information scientists and engineers, or methodologically and ethnographically trained information scientists who can get through to the core of a discipline? Knowledge about that would help define mutual expectations and make collaboration smoother, more effective, and—last but not least—more rewarding for all.

Draft

References

Antoniou, G., Groth, P., van Harmelen, F., and Hoekstra, R. (2012). A semantic web primer (3rd ed.). Cambridge, Mass.: MIT Press.

Baeza-Yates, R., and Ribeiro-Neto, B. (2011). Modern information retrieval. The concepts and technology behind search (2nd ed.). New York: Addison Wesley.

Barrionuevo, L. (2011). Libraries for users. Services in academic libraries. Oxford: Chandos Publishing.

Batley, S. (2005). Classification in theory and practice. Oxford: Chandos Publishing.

Bawden, D. (2001). ‘Information and digital literacies: A review of concepts’. *Journal of Documentation 57*(2), pp. 218-259. doi:10.1108/EUM0000000007083.

Bawden, D., and Robinson, L. (2012). An introduction to information science. London: Facet.

Berners-Lee, T., Hendler, J., and Lassila, O. (2001). ‘The semantic web’. *Scientific American 284*(5), pp. 28-37.

Borgman, C. L. (2007). Scholarship in the digital age: Information, infrastructure, and the internet. Cambridge, Mass.: MIT Press.

Borlund, P. (2013). ‘Interactive information retrieval: An introduction’. *Journal of Information Science Theory and Practice 1*(3), pp. 12-32. doi:10.1633/JISTaP.2013.1.3.2.

Bos, N., Zimmerman, A., Olson, J. S., Yew, J., Yerkie, J., Dahl, E., . . . Olson, G. M. (2008). ‘From shared databases to communities of practice: A taxonomy of collaboratories’. In: Scientific collaboration on the internet. Ed. by G. M. Olson, A. Zimmerman and N. Bos. Cambridge, Mass.: MIT Press.

Broughton, V. (2006). Essential thesaurus construction. London: Facet.

Bruce, C. (1998). ‘The phenomenon of information literacy’. *Higher Education Research & Development 17*(1), pp. 25-43. doi:10.1080/0729436980170102.

Calvert, P. J. (2015). Information needs analysis, principles and practice in information organizations. London: Facet.

Case, D. O. (2012). Looking for information. A survey of research on information seeking, needs and behavior (3rd ed.). Bingley: Emerald.

Chowdhury, G. G. (2010). Introduction to modern information retrieval (3rd ed.). London: Facet.

Cummings, J. N., and Kiesler, S. (2008). ‘Collaborative research across disciplinary and organizational boundaries’. In: Scientific collaboration on the internet. Ed by G. M. Olson, A. Zimmerman and N. Bos. Cambridge, Mass.: MIT Press.

Eggert, P. (2009). ‘The book, the E-text and the 'work-site''. In: Text editing, print and the digital world. Ed. by M. Deegan, and K. Sutherland. Farnham: Ashgate.

Elsayed, I., Madey, G., and Brezany, P. (2011). ‘Portals for collaborative research communities: Two distinguished case studies’. *Concurrency and Computation: Practice and Experience 23*(3), pp. 269-278. doi:10.1002/cpe.1685.

Engerer, V., and Albretsen, J. (in prep.). ‘The Prior internet resources 2017: Information systems and development perspectives. To appear in: Proceedings of the annual project meeting of the Prior-group, Skagen, Denmark, May 30-June 1, 2017. Aalborg, Denmark: Aalborg University Publishers.

Engerer, V., Roued-Cunliffe, H., Albretsen, J., and Hasle, P. F. V. (2017). ‘The Prior project: From archive boxes to a research community’. DHN 2017 Digital Humaniora i Norden/ Digital Humanities in the Nordic Countries, Gothenburg, March 14–16 2017 CONFERENCE ABSTRACTS, Gothenburg, Sweden.

Finholt, T. A. (2002). ‘Collaboratories’. *Annual Review of Information Science and Technology 36*(1), pp. 73-107. doi:10.1002/aris.1440360103.

Flanders, J. (2012). ‘Collaboration and dissent: Challenges of collaborative standards for digital humanities’. In: Collaborative research in the digital humanities. Ed. by M. Deegan, and W. McCarty. Farnham, Surrey, England: Ashgate Pub.

Grassian, E. S., and Kaplowitz, J. R. (2009). Information literacy instruction: Theory and practice (2nd ed.). New York: Neal-Schuman Publishers.

Hider, P. (2012). Information resource description: Creating and managing metadata. London: Facet.

Draft

Hjørland, B. (1998). 'Information retrieval, text composition, and semantics'. *Knowledge Organization 25*(1/2), pp. 16-31.
Hjørland, B. (2002). 'Domain analysis in information science: Eleven approaches – traditional as well as innovative'. *Journal of Documentation 58*(4), pp. 422-462. doi:10.1108/00220410210431136.
Hjørland, B. (2003). 'Fundamentals of knowledge organization'. *Knowledge Organization 30*(2), pp. 87-111.
Hjørland, B. (2008). 'What is knowledge organization (KO)?'. *Knowledge Organization 35*(2/3), pp. 86-101.
Hockey, S. (2012). 'Digital humanities in the age of the internet: Reaching out to other communities'. In: Collaborative research in the digital humanities. Ed. by M. Deegan, and W. McCarty. Farnham, Surrey, England: Ashgate Pub.
Kimmerle, J., Cress, U., and Moskaliuk, J. (2012). 'Wiki-supported knowledge building - theory, research, and application'. In: Wiki supporting formal and informal learning. Ed. by S. Bocconi, and G. Trentin. Hauppauge, N.Y.: Nova Science Publishers.
King, B. E., and Reinold, K. (2008). Finding the concept, not just the word, a librarian's guide to ontologies and semantics. Oxford: Chandos.
Lancaster, F. W. (2003). Indexing and abstracting in theory and practice (3rd ed.). London: Facet.
Lloyd, A. (2010). Information literacy landscapes. Information literacy in education, workplace and everyday contexts. Oxford: Chandos Pub.
Olson, J. S., Hofer, E. C., Bos, N., Zimmerman, A., Olson, G. M., Cooney, D., and Faniel, I. (2008). 'A theory of remote scientific collaboration'. In: Scientific collaboration on the internet. Ed by G. M. Olson, A. Zimmerman and N. Bos. Cambridge, Mass.: MIT Press.
Owusu-Ansah, E. K. (2005). 'Debating definitions of information literacy: Enough is enough!' *Library Review 54*(6), pp. 366-374.
Prior Project Group. (2017). The primacy of tense: A.N. Prior now and then (project website). Retrieved from http://www.prior.aau.dk/.
Ramage, M. A. (2010). 'Evaluating collaborative technologies - a simple method'. In: Online communication and collaboration: A reader. Ed. by H. M. Donelan, K. L. Kear and M. A. Ramage. New York, NY: Routledge.
Ruthven, I., and Kelly, D. (2011). Interactive information seeking, behaviour and retrieval. London: Facet.
Sinkinson, C., and Lingold, M. C. (2010). 'Re-visioning the library seminar through a lens of critical pedagogy'. In: Critical library instruction. theories & methods. Ed. by M. T. Accardi, E. Drabinski and A. Kumbier. Duluth, Minnesota: Library Juice Press.
Stock, W. G., and Stock, M. (2013). 'Information literacy'. In: Handbook of information science. By W. G. Stock and M. Stock. Berlin: deGruyter Saur.
Stuart, D.P. (2015). Practical ontologies for information professionals. London: Facet Publishing.
Svenonius, E. (2000). The intellectual foundation of information organization. Cambridge, Mass: MIT Press.
Tredinnick, L. (2006). Digital information contexts: Theoretical approaches to understanding digital information. Oxford: Chandos Publishing.
Tredinnick, L. (2007). Digital information culture: The individual and society in the digital age. Oxford: Chandos.
Zaugg, H., West, R. E., Tateishi, I., and Randall, D. L. (2011). 'Mendeley: Creating communities of scholarly inquiry through research collaboration'. *TechTrends 55*(1), pp. 32-36.

Draft

Table 1. Information Scientists Connecting With Domain Research in Three Ways

Research activities dimension → Information science dimension ↓	Individual: research (learning, first order knowledge building, cognitive activities)	Group (team, project): scientific communication (research-related communication)	Community: scientific communication research (second-order knowledge building)
Information scientist/ specialist (individual professional activity)	[1: Library support]	2: Developing scientific communication infrastructure	3: Information specialist's meta knowledge (domain analysis, ontologies)

Draft