Portraying the Landscape of Canadian Library and Information Science Research = Portrait de la recherche en bibliothéconomie et sciences de l'information au Canada

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Abstract: This article provides a global portrait of the current library and information science (LIS) research community in Canada. Analyzing the scientific production of Canadian LIS faculty members, we look more specifically at disciplines and country affiliations of co-authors and research topics of faculty members. Our results depict a mostly national and LIS-oriented network of collaboration.

Keywords: bibliometrics, library and information science, collaboration, research topics, Canada

Résumé : Cette étude vise à fournir un portrait global de la communauté de recherche en bibliothéconomie et sciences de l'information au Canada. L'analyse de l'affiliation disciplinaire, du pays d'affiliation des coauteurs ainsi que des sujets de recherche des professeurs en sciences de l'information dépeint une communauté principalement canadienne et majoritairement affiliée à des institutions des sciences de l'information.

Mots-clés : bibliométrie; bibliothéconomie et sciences de l'information, collaboration, sujets de recherche, Canada

Introduction

The knowledge and intellectual structure of a field can be studied through various methods. However, these methods have one point in common; they rely on published documents. According to Yu-Wei Chang, Mu-Hsuan Huang, and Chiao-Wen Lin (2015), three main methods have been used to study library and information science (LIS) as a field: content analysis of published literature, bibliographic analysis, and a combination of various methods belonging to either the first or second category. Bibliographic analyses are mostly based on keywords, co-citations, co-authorship, and bibliographical coupling. Chang and Huang (2012) used direct citations, bibliographic coupling, and co-authorship analyses for publications from 1978 to 2007 and found that LIS researchers

heavily cite publications of fellow LIS researchers and that most co-authors of LIS articles are affiliated with LIS-related institutions. In their bibliometric analysis of the first hundred years of LIS research, Vincent Larivière, Cassidy Sugimoto, and Blaise Cronin (2012, 998) used a combination of content analysis and bibliographic methods (terms, topics, and citations) to show that even though LIS programs are fewer in number and in size than some other social sciences and humanities departments, they have developed through their history an "identifiable institutional character and share a distinct academic/ professional ethos."

However, disciplines and their constitutive communities do not evolve in silos. LIS research shares topics, tools, and methods with other disciplines, which, in turn, influence each other. In fact, many authors have discussed the interdisciplinary nature of the LIS field (for example, Bates 2007; Vickery 1997). Marcia Bates (1999) described information science as a meta-field with links in all traditional fields of scientific inquiry, from arts and humanities to natural sciences and mathematics. She also showed how the spectrum of topics and sub-topics that are of interest to the information science community are aligned with the spectrum of traditional disciplines. In this sense, LIS is not a monolithic block forming one unique community of interrelated scholars but, rather, can be perceived as a multitude of smaller communities that together form one large community. In addition to those many internal communities, the interdisciplinary nature of LIS suggests that the field itself has permeable boundaries and that LIS scholars also participate in many communities outside the boundaries of the field. Noa Aharony (2012, 33) found evidence of this "distinct tendency towards multi-disciplinarity" in his analysis of articles published in the top ten journals of LIS. Indeed, there are ongoing discussions about the either multi- or interdisciplinary nature of the LIS field. In this article, we use the term "interdisciplinary" as a form of integration of knowledge and methods from various fields, as defined by George Holland (2008). This term seems to appropriately reflect the nature of collaborative ties as operationalized through co-authorship. Numerous context-specific studies investigating LIS research in particular countries have been published in the last decade (for example, in Slovakia, Botswana, Great Britain, Korean, Pakistan, Poland, Spain, and China). From these studies, we know that what is published and read in a scientific community is shaped by geography, language, and political systems. Journals, topics of interest, authorship practices, and referencing styles vary significantly depending on the country and language of communication (Larivière, Sugimoto, and Cronin 2012; Naseer and Mahmood 2014; Yang, Lee, and Choi 2016). The purpose of this article is thus to provide a portrait of the current LIS academic community in Canada. The Canadian LIS research landscape will be analyzed using the scientific production of its faculty members to identify its constitutive sub-communities based on their collaborators' disciplines and countries of affiliation. More specifically, this article aims to provide answers to the following research questions:

1. With which countries are Canadian LIS authors collaborating?
2. With which disciplines are Canadian LIS authors collaborating?
3. What are the self-declared research topics of Canadian LIS faculty members?

Methodology

For the purposes of the present study, the Canadian LIS research community members are defined as all faculty members affiliated to a school or department of LIS in a Canadian university according to the Association for Library and Information Science Education's (ALISE) (2013) Directory of Library and Information Science Programs and Faculty, which includes the following eight institutions: Dalhousie University, McGill University, University of Alberta, University of British Columbia, Université de Montréal, University of Ottawa, University of Toronto, and University of Western Ontario.

The ALISE directory also provides the research and teaching areas of each faculty member following ALISE's LIS Research Areas Classification Scheme. The LIS Research Areas Classification Scheme classifies LIS research and teaching topics into 104 topics that are aggregated into ten larger areas: development/ principles of LIS, the organization of information, LIS education, information systems and retrieval, collection development, types of libraries and information providers, services to user populations, management/administration, informatics, and school libraries. Although we acknowledge the limitations related to the LIS Research Areas Classification Scheme, given its subjective nature in representing faculty members' perceptions regarding their research and teaching areas when compared to more objective measures (that is, publications), the ALISE directory is a valid and reliable data source. ALISE (2016) states:

> The Directory of Library and Information Sciences Programs and Faculty provides a complete listing of the faculty of ALISE Institutional Member schools of library and information science, along with the teaching and research areas of each faculty member in accordance with ALISE's LIS Research Areas Classification Scheme. This scheme should prove useful for identifying research and teaching specialties across the LIS community.

A manual update of ALISE's 2013 directory was done in July 2015 and used as a source for this study. The following analyses are based on the publications of the 120 faculty members listed in the updated ALISE directory.

Typically, bibliometric analyses are performed using databases such as the Web of Science and Scopus. However, numerous studies have found that these data sources do not cover extensively social sciences and arts and humanities (Archambault, Vignola-Gagné, Côté, Larivière and Gingras 2006; Gavel and Iselid 2008; Hicks and Wang, 2011). Philippe Mongeon and Adèle Paul-Hus (2016) have also shown that Web of Science and Scopus's journal coverage have a strong English-language overrepresentation, which can have an important effect when considering the scientific output of a research community such as

the Canadian LIS community where English is not the sole language of publication. Thus, using Web of Science and Scopus can only provide an incomplete portrait of an interdisciplinary field like LIS.

Google Scholar provides free access to scholarly documents of all types, languages, and for all fields. Even though its suitability for bibliometric analyses has been questioned in regard to various inconsistencies in the data (Clermont and Dyckhoff 2012) and a lack of transparency of the coverage (Wouters and Costas 2012), it remains the most comprehensive source of scientific documents. Comparing bibliometric indicators of LIS scholars using Web of Science, Scopus, and Google Scholar, Lokman Meho and Kiduk Yang (2007) have shown that Google Scholar had the most extensive coverage of conference proceedings and non-English language journals. With these considerations in mind, we used Google Scholar to retrieve manually all research articles, proceedings, reviews, book chapters, and monographs published between 2010 and 2015 by all members of the Canadian LIS community. We included only faculty members active in 2015 and retrieved documents published after the authors had joined their respective LIS departments. We chose the 2010–15 period to provide a current (not historical) portrait of the LIS faculty members' collaborations. Since we looked at each paper, this six-year window also made the data collection more manageable.

A total of 1,580 publications by 1,446 distinct authors were retrieved through Google Scholar. In comparison, a similar search in the Web of Science retrieved less than 21 percent (331 publications) of these same LIS faculty members' output. Moreover, for each publication, we retrieved all collaborators and their affiliation (country, institution, and department) to map the collaborative ties of Canadian LIS faculty.

Once the data collection was completed, disciplines were assigned to each author of the corpus, based on their departmental (or institutional) affiliation as indicated on their publications and using the National Science Foundation discipline classification (National Science Foundation 2006). It should be noted that given the LIS focus of our analysis, an inclusive conception of LIS as a field was favoured here, and authors either affiliated with a LIS school, department, library, or archives centre were all included under the "Information Science and Library Science" National Science Foundation category. Country assignation for each author was also based on the institutional affiliation.

We used the open-source software Gephi, a standard tool in network visualization, to visualize the communities formed by self-declared research and teaching topics of interests of faculty members, as indicated in the ALISE directory. A link is formed between two topics when they are both associated to a single faculty member. The weight of a topic is measured by the number of individuals associated with it. To define clusters of topics of interest, we used the Louvain method for community detection, which is a "heuristic method that is based on modularity optimization" implemented in Gephi (Blondel, Guillaume, Lambiotte, and Lefebvre, 2008, P10008).

Results

Scholarly production

Table 1 presents the scholarly production of Canadian LIS schools and departments for the 2010–15 period. Schools and departments vary greatly in size, ranging from seven faculty members (6 percent of all Canadian LIS faculty members) at the School of Information Management at Dalhousie University to thirty-three (28 percent of all faculty members) at the Faculty of Information at the University of Toronto. The scholarly output of each school and department faithfully reflects these variations in size, with Dalhousie University and University of Toronto respectively accounting for 6 percent and 23 percent of the total output. Almost half (48 percent) of the scholarly output was published as research articles, 39 percent as conference proceedings, and less than 13 percent as books or book chapters. These results confirm that the main means of knowledge diffusion in LIS remains the research article, which contrasts with other fields that are close to LIS in terms of collaboration. For instance, in computer science and engineering, conference proceedings are the dominant form of scholarly diffusion, whereas in history, books are prominent.

Based on worldwide bibliographic data retrieved from Web of Science and covering more than a century of publications (1900–2010), Larivière, Sugimoto, and Cronin (2012) found that sole authorship was the norm in LIS publications until the 1960s when co-authorship started to increase to attain an average of 2.4 authors per article in 2010. The Canadian corpus shows similar results with an average of 2.5 authors per article for the 2010–15 period and an average of 2.7 authors per publication when considering all types of documents.

Countries of collaborators

Table 2 shows the country of affiliation of the 1,425 authors for whom the information was available (the country affiliation of twenty-three authors could not be found). Even though Canadian LIS faculty members collaborated with researchers from forty-three different countries, more than 58 percent of the co-authors of our corpus were affiliated to a Canadian institution, depicting a mostly national network of collaboration. The United States appears as the closest collaborating country with 18 percent of authors in our corpus affiliated to an American institution. The remaining countries of collaboration appear as marginal with shares of less than 5 percent of authors for each country.

Disciplines of collaborators

The analysis of authors' affiliation shows that most (71 percent) of authors included in our corpus are affiliated to LIS schools, departments, or institutions (for example, archives or libraries). Professional collaborators, affiliated to libraries or other information sciences institutions represent less than 5 percent of all LIS authors in our corpus. The proportions of authors from the LIS field vary from 62 percent for Dalhousie University to 80 percent for the University of Alberta. However, it should be noted that from the 1,448 distinct authors in our data

Table 1: Scholarly production of Canadian LIS schools and departments, 2010–15

University	Department / School	Faculty members No. (%)	Articles No. (%)	Conference proceedings No. (%)	Books / book chapters No. (%)	Total publications No. (%)
Dalhousie University	School of Information Management	7 (6)	44 (3)	42 (3)	12 (1)	98 (6)
McGill University	School of Information Studies	13 (11)	99 (6)	90 (6)	27 (2)	216 (14)
Université de Montréal	École de bibliothéconomie et des sciences de l'information	15 (13)	111 (7)	63 (4)	31 (2)	20 (13)
University of Alberta	School of Library and Information Studies	8 (7)	57 (4)	39 (2)	12 (1)	108 (7)
University of British Columbia	School of Library, Archival and Information Studies	12 (10)	63 (4)	86 (5)	18 (1)	167 (11)
University of Ottawa	School of Information Studies	9 (8)	55 (3)	8 (1)	17 (1)	80 (5)
University of Toronto	Faculty of information	33 (28)	144 (9)	168 (11)	53 (3)	365 (23)
University of Western Ontario	Faculty of Information and Media Studies	23 (19)	190 (12)	120 (8)	31 (2)	341 (22)
Total		120 (100)	763 (48)	616 (39)	201 (13)	1580 (100)

Table 2: Authors' country of affiliation by school or department

	Dalhousie University	McGill University	Université de Montréal	University of Alberta	University of British Columbia	University of Ottawa	University of Toronto	University of Western Ontario	Total
	No. (%)	No (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Canada	60 (61)	120 (55)	72 (62)	41 (59)	115 (64)	35 (55)	257 (59)	149 (58)	849 (59)
United States	19 (19)	48 (22)	15 (13)	14 (20)	31 (17)	16 (25)	71 (16)	50 (19)	264 (18)
United Kingdom	2 (2)	14 (6)	8 (7)	0 (0)	6 (3)	2 (3)	29 (7)	9 (3)	70 (5)
France	4 (4)	5 (2)	0 (0)	1 (1)	5 (3)	2 (3)	9 (2)	2 (1)	28 (2)
China	1 (1)	2 (1)	4 (3)	1 (1)	5 (3)	2 (3)	4 (1)	8 (3)	27 (2)
Germany	0 (0)	4 (2)	1 (1)	1 (1)	1 (1)	2 (3)	10 (2)	6 (2)	25 (2)
Italy	2 (2)	0 (0)	1 (1)	1 (1)	3 (2)	1 (2)	2 (0)	3 (1)	13 (1)
Greece	0 (0)	2 (1)	1 (1)	2 (3)	1 (1)	0 (0)	4 (1)	2 (1)	12 (1)
Israel	0 (0)	2 (1)	0 (0)	0 (0)	4 (2)	1 (2)	3 (1)	1 (0)	11 (1)
Sweden	1 (1)	3 (1)	0 (0)	1 (1)	0 (0)	0 (0)	5 (1)	1 (0)	11 (1)
Australia	0 (0)	1 (0)	2 (2)	3 (4)	0 (0)	0 (0)	3 (1)	1 (0)	10 (1)
Netherlands	0 (0)	3 (1)	1 (1)	1 (1)	1 (1)	0 (0)	4 (1)	0 (0)	10 (1)
Austria	1 (1)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (1)	0 (0)	8 (1)
Denmark	0 (0)	1 (0)	0 (0)	0 (0)	0 (0)	0 (0)	5 (1)	2 (1)	8 (1)
Nigeria	0 (0)	1 (0)	2 (2)	2 (3)	0 (0)	1 (2)	0 (0)	2 (1)	8 (1)
29 other countries	<1%								

Note: The country affiliation of twenty-three authors is unknown

Table 3: Disciplines of co-authors by university (excluding LIS)

	Dalhousie University	McGill University	Université de Montréal	University of Alberta	University of British Columbia	University of Ottawa	University of Toronto	University of Western Ontario	Total
	No (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)	No. (%)
Computer Science	**44 (42)**	**79 (39)**	**53 (35)**	3 (6)	**40 (34)**	5 (10)	**220 (50)**	**65 (24)**	**509 (36)**
Health	6 (6)	3 (1)	0 (0)	6 (12)	1 (1)	6 (12)	43 (10)	41 (15)	106 (8)
Arts and Humanities	1 (1)	20 (10)	10 (7)	**27 (52)**	6 (5)	0 (0)	26 (6)	12 (4)	102 (7)
Clinical Medicine	2 (2)	23 (11)	1 (1)	1 (2)	1 (1)	1 (2)	23 (5)	41 (15)	93 (7)
Communication and Media	2 (2)	3 (1)	1 (1)	2 (4)	17 (15)	3 (6)	19 (4)	8 (3)	55 (4)
Management	10 (9)	4 (2)	2 (1)	0 (0)	9 (8)	1 (2)	9 (2)	15 (6)	50 (4)
Engineering and Technology (Others)	0 (0)	24 (12)	11 (7)	0 (0)	0 (0)	0 (0)	5 (1)	0 (0)	40 (3)
Natural Sciences	16 (15)	13 (6)	0 (0)	0 (0)	1 (1)	2 (4)	3 (1)	4 (1)	39 (3)
Social Sciences (Others)	1 (1)	3 (1)	5 (3)	0 (0)	1 (1)	1 (2)	6 (1)	21 (8)	38 (3)
Sociology	9 (8)	0 (0)	5 (3)	0 (0)	2 (2)	8 (15)	3 (1)	10 (4)	37 (3)
Science Studies	0 (0)	0 (0)	32 (21)	1 (2)	0 (0)	0 (0)	2 (0)	1 (0)	36 (3)
Law	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	**20 (38)**	0 (0)	9 (3)	30 (2)
Education	0 (0)	4 (2)	0 (0)	6 (12)	3 (3)	0 (0)	5 (1)	8 (3)	26 (2)
Political Science and Public Administration	1 (1)	0 (0)	3 (2)	0 (0)	3 (3)	0 (0)	16 (4)	3 (1)	26 (2)
Psychology	0 (0)	6 (3)	2 (1)	1 (2)	0 (0)	0 (0)	4 (1)	2 (1)	15 (1)
Geography	2 (2)	3 (1)	8 (5)	0 (0)	0 (0)	1 (2)	0 (0)	0 (0)	14 (1)
Language and Linguistics	0 (0)	1 (0)	4 (3)	2 (4)	1 (1)	3 (6)	2 (0)	1 (0)	14 (1)
Multidisciplinary	0 (0)	0 (0)	3 (2)	0 (0)	1 (1)	0 (0)	1 (0)	5 (2)	10 (1)
Unknown	12 (11)	19 (9)	11 (7)	3 (6)	30 (26)	1 (2)	55 (12)	25 (9)	156 (11)

Note: Figures in bold indicate the highest number and percentage for each university.

set, the discipline's affiliation of 112 authors could not be found; of those, fifty-one were affiliated to private companies.

To examine the interdisciplinary nature of Canadian LIS research, Table 3 presents the disciplinary affiliation of authors contributing to the research output, excluding affiliation to LIS institutions. Disciplines for which less than ten distinct affiliations were found were merged into larger groups: Social Sciences (others), thus, includes anthropology, criminology, economics, and social work; Natural Sciences includes disciplines such as chemistry, environmental science, and mathematics; and Engineering and Technology (others) regroups all engineering disciplines with the exception of computer science.

The closest discipline to LIS, in terms of the number of co-authors' affiliation, appears to be computer science, which represents 36 percent of all non-LIS affiliations, all universities taken together. However, computer science is particularly important at the University of Toronto (50 percent) and Dalhousie University (42 percent). Authors affiliated to health disciplines (for example, nursing, public health, rehabilitation, and geriatrics and gerontology) represent an important proportion of non-LIS collaborators at the University of Western Ontario (15 percent), the University of Ottawa (12 percent), and the University of Alberta (12 percent). Affiliation to arts and humanities disciplines (for example, arts and architecture, design, history, literature, and philosophy) appears to represent more than half (52 percent) of all non-LIS contributors at the University of Alberta. This could be due to the school's appurtenance to the Faculty of Arts and that it offers a combined Master of Arts in Humanities Computing / Master of Library and Information Studies Program. Collaborators from law represent 38 percent of non-LIS collaborators at the University of Ottawa. The proximity with law at the University of Ottawa can probably be explained by the collaborators of a cross-appointed professor affiliated to both the Faculty of Law and the School of Information Studies. Science studies represents a significant field of collaboration for Université de Montréal authors with a share of 21 percent of non-LIS collaborators, which is the result of a single professor's numerous contributions to that field of study. Finally, authors affiliated to communication and media appear as an important field of collaboration for the University of British Columbia, while collaborators from Natural Sciences disciplines are mostly associated with authors from Dalhousie University.

Research and teaching topics

Figure 1 shows the network of topics communities based on LIS faculty members' research and teaching topics of interest (ALISE 2013). Six clusters were defined using Blondel's algorithm. The technology oriented topics – which include topics like information systems and technologies, information visualization, users and uses of information systems, information retrieval, and human-computer interaction – constitute the most central cluster. Indeed, the two most frequent topics of the whole network are information systems and technologies and human-computer interaction, respectively mentioned by 24 percent and 18 percent of faculty members. Users and uses of information systems, information and
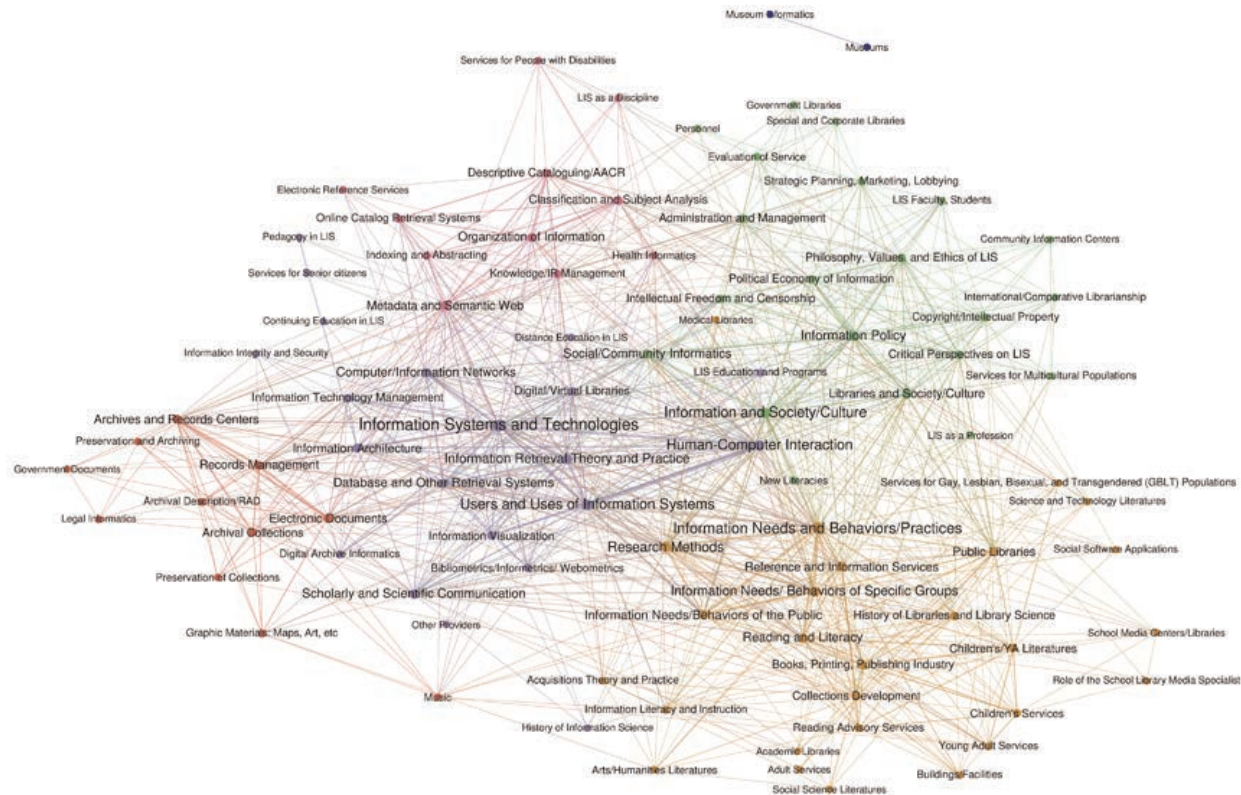
Figure 1: Communities formed around research and teaching topics of Canadian LIS faculty members

society/culture, and information needs and behaviours/practices constitute the remaining core topics of Canadian LIS faculty members, with frequencies of more than 15 percent.

Four other main clusters are formed around the technology-oriented cluster; the users and services-oriented cluster, the archival-oriented cluster, the cataloguing and indexing-oriented cluster and the LIS philosophy, policy, and management-oriented cluster. These five topics communities form the main component of the network. Finally, an isolated cluster of museum-oriented topics is found at the periphery of the network.

Each of the other clusters shows a technology-related aspect that explains the centrality of the technology-oriented cluster. Furthermore, these topics are typically situated closer to the centre of the network. For instance, the metadata and semantic web topic form an important bridge between the cataloguing and indexing cluster and the technology cluster. The electronic documents topic creates a similar bridge between the archives cluster and the technology cluster. In the users and services cluster, information needs and behaviours/practices, and research methods are the two topics most closely interconnected to the technology cluster. Information and society/culture—a topic that belongs to the LIS philosophy, policy, and management cluster—form an important bridge with the technology cluster, but it is also connected to other clusters. This reflects the rather broad nature of that particular topic within the LIS field.

Looking closely at clusters' composition, some topics' appurtenance to a certain cluster can appear counter-intuitive. This is the case with pedagogy in LIS and services for senior citizens, which, according to our data, belong to the technology cluster. However, in this example, this association is the result of a single individual's interest in those two topics as well as in information architecture and human-computer interaction. The absence of connections between the museum-oriented topics' cluster and the main component of the network shows a clear delimitation of two distinct areas of research. Inversely, none of the five other communities appears isolated from the others, which means that faculty members are interested in diversified topics that belong to different clusters. As shown in Figure 2, the number of topics of interest for faculty members of the Canadian community ranges between one and fourteen with a mean of 4.9. More than 80 percent of the faculty members have three or more topics of interest.

Limitations

Some limitations of this study should be acknowledged. First, in this study, the Canadian LIS community was limited to faculty members of LIS schools or departments, which represent the core group of scholars who contribute to the LIS research landscape in the country. However, LIS students and professionals also contribute to the research in the field. These contributions are captured in our data set when they are done in collaboration with LIS faculty members, but they would not be included if they were not produced in collaboration with faculty members.
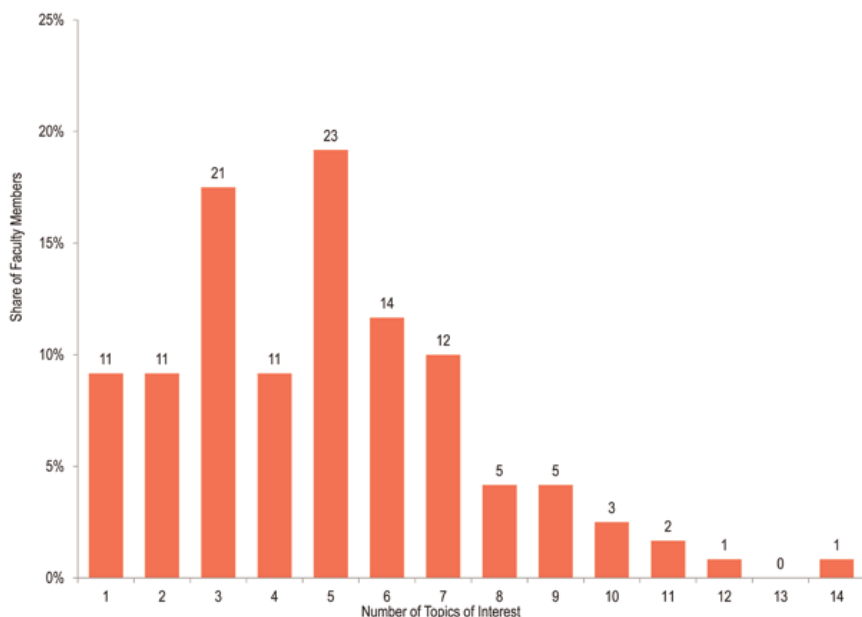
Figure 2: Share of faculty members by number of topics of interest

Second, another potential limitation is inherent to the source used to analyze the research and teaching topics of interest. ALISE data has its own limitations since the research and teaching areas are self-reported by faculty members. Moreover, ALISE's research areas classification is restricted to LIS-related topics. Hence, faculty members' topics of interest are limited to the classification proposed and do not cover topics outside the boundaries of LIS. As a result, the topics of interests presented in the network in Figure 1 may be slightly skewed toward traditional library science.

Finally, the relatively small number of faculty members (Canadian faculty members listed in the ALISE directory) included in the topics' network analysis can also constitute a limitation. Indeed, the defined clusters show some counter-intuitive associations between certain specific topics that can be, for example, caused by the fact that a single researcher is interested in a particular combination of topics. Generally speaking, such limitations could be avoided by using larger data sets. However, this was not possible in the present case since the whole population of Canadian LIS faculty members was included and analyzed.

Discussion and conclusion

This article provides a global portrait of the current LIS research in Canada looking more specifically at the various communities that emerge from the collaborative knowledge production faculty members. Our findings show a highly national and interdisciplinary network, with many collaborators affiliated to fields

outside of LIS. The interdisciplinary nature of the LIS field, which was recently demonstrated by William Walters and Esther Wilder (2016) with an extensive analysis of refereed articles published in thirty-one LIS journals from 2007 to 2012, is further corroborated with our results that show the multiple and diverse disciplines with which Canadian LIS faculty members collaborate (Table 3). However, our results also show that collaboration with co-authors from the same field is stronger than with co-authors from another field since more than 71 percent of authors contributing to the Canadian LIS research output are affiliated to LIS-related institutions. The Canadian LIS community appears to behave in a manner that is similar to what is observed worldwide as our results corroborate what was found by Chang and Huang (2012). This level of collaboration with other disciplines is similar to what was found in the social sciences by Mario Karlovčec and Dunja Mladenić (2015) where 73 percent of collaborators on social sciences projects were from social sciences, whereas, in natural sciences, they found that only 58 percent of collaborators were from the natural sciences.

Our analysis of ALISE's LIS Research Areas Classification Scheme put forward the diversified research and teaching topics of interest of the Canadian LIS community. However, the most frequent topics belong to the broader area of information systems and retrieval, corroborating what was previously found by Denise Koufogiannakis, Linda Slater, and Ellen Crumley (2004). Their content analysis of more than 800 LIS journal articles showed that the most frequent subject domain was information access and retrieval.

In the past decades, multiple authors have discussed the very nature of LIS as a field, and many have questioned the fact that the field's constituting disciplines and specific research topics actually form a united and autonomous whole (Fondin, 2006; Wilson 2002). However, a recent analysis of LIS doctoral dissertations' topics found that LIS constitutes an interdisciplinary field where library science and information science are intimately related (Shu, Larivière, Mongeon, Julien, and Piper 2016). In that line, the analysis of self-declared research and teaching topics of interest of Canadian LIS faculty members (Figure 1) shows a highly interconnected network that demonstrates that LIS does form a coherent but multifaceted field and not a simple combination of heterogeneous topics.

Acknowledgements

References

Aharony, Noa. 2012. "Library and Information Science Research Areas: A Content Analysis of Articles from the Top Ten Journals 2007–8." *Journal of Librarianship and Information Science* 44 (1): 27–35. http://dx.doi.org/10.1177/0961000611424819.

Association for Library and Information Science Education (ALISE). 2013. *Directory of Library and Information Sciences Programs and Faculty*. Chicago: ALISE.

ALISE. 2016. ''ALISE 2013 Directory of Library and Information Science Programs and Faculty: United States and Canada.'' http://www.alise.org/lis-programs-faculty (last accessed 4 January 2017).

Archambault, Éric, Éric Vignola-Gagné, Grégoire Côté, Vincent Larivière, and Yves Gingras. 2006. ''Benchmarking Scientific Output in the Social Sciences and Humanities: The Limits of Existing Databases.'' *Scientometrics* 68 (3): 329–42. http://dx.doi.org/10.1007/s11192-006-0115-z.

Bates, Marcia J. 1999. ''The Invisible Substrate of Information Science.'' *Journal of the Association for Information Science and Technology* 50 (12): 1043–50.

——. 2007. ''Defining the Information Disciplines in Encyclopedia Development.'' *Information Research* 12 (4): 29. http://www.informationr.net/ir/12-4/colis/colis29.html.

Blondel, Vincent D., Jean-Loup Guillaume, Renaud Lambiotte, and Etienne Lefebvre. 2008. ''Fast Unfolding of Communities in Large Networks.'' *Journal of Statistical Mechanics* 10: P1008–12. http://dx.doi.org/10.1088/1742-5468/2008/10/P10008

Chang, Yu-Wei, and Mu-Hsuan Huang. 2012. ''A Study of the Evolution of Inter-disciplinarity in Library and Information Science: Using Three Bibliometric Methods.'' *Journal of the Association for Information Science and Technology* 63 (1): 22–33. http://dx.doi.org/10.1002/asi.21649.

Chang, Yu-Wei, Mu-Hsuan Huang, and Chiao-Wen Lin. 2015. ''Evolution of Research Subjects in Library and Information Science Based on Keyword, Bibliographical Coupling, and Co-Citation Analyses.'' *Scientometrics* 105 (3): 2071–87. http://dx.doi.org/10.1007/s11192-015-1762-8.

Clermont, Marcel, and Haral Dyckhoff. 2012. *Coverage of Business Administration Literature in Google Scholar: Analysis and Comparison with Econbiz, Scopus and Web of Science*, SSRN Scholarly Paper no. ID 2016850. Rochester, NY: Social Science Research Network. http://dx.doi.org/10.2139/ssrn.2016850 (last accessed 5 January 2015).

Fondin, Hubert. 2006. ''La science de l'information ou le poids de l'histoire. '' http://lesenjeux.u-grenoble3.fr/2005/Fondin/fondin.pdf (last accessed 5 January 2015).

Gavel, Ylva, and Lars Iselid. 2008. ''Web of Science and Scopus: A Journal Title Overlap Study.'' *Online Information Review* 32 (1): 8–21. http://dx.doi.org/10.1108/14684520810865958.

Hicks, Diana, and Jian Wang. 2011. ''Coverage and Overlap of the New Social Sciences and Humanities Journal Lists.'' *Journal of the American Society for Information Science and Technology* 62 (2): 284–94. http://dx.doi.org/10.1002/asi.21458.

Holland, George. 2008. ''Information Science: An Interdisciplinary Effort?'' *Journal of Documentation* 64 (1): 7–23. http://dx.doi.org/10.1108/00220410810844132.

Karlovčec, Mario, and Dunja Mladenić. 2015. ''Interdisciplinarity of Scientific Fields and Its Evolution Based on Graph of Project Collaboration and Co-Authoring.'' *Scientometrics* 102 (1): 433–54. http://dx.doi.org/10.1007/s11192-014-1355-y.

Koufogiannakis, Denise, Linda Slater, and Ellen Crumley. 2004. ''A Content Analysis of Librarianship Research.'' *Journal of Information Science* 30 (3): 227–39. http://dx.doi.org/10.1177/0165551504044668.

Larivière, Vincent, Cassidy R. Sugimoto, and Blaise Cronin. 2012. ''A Bibliometric Chronicling of Library and Information Science's First Hundred Years.'' *Journal of the American Society for Information Science and Technology* 63 (5): 997–1016. http://dx.doi.org/10.1002/asi.22645.

Meho, Lokman I., and Kiduk Yang. 2007. ''Impact of Data Sources on Citation Counts and Rankings of LIS faculty: Web of Science versus Scopus and Google Scholar.'' *Journal of the American Society for Information Science and Technology* 58 (13): 2105–25. http://dx.doi.org/10.1002/asi.20677.

Mongeon, Philippe, and Adèle Paul-Hus. 2016. ''The Journal Coverage of Web of Science and Scopus: A Comparative Analysis.'' *Scientometrics* 106 (1): 213–28. http://dx.doi.org/10.1007/s11192-015-1765-5.

Naseer, Mirza Muhammad, and Khalid Mahmood. 2014. ''Subject Dispersion of LIS Research in Pakistan.'' *Library and Information Science Research* 36 (2): 114–19. http://dx.doi.org/10.1016/j.lisr.2013.10.005.

National Science Foundation. 2006. Science and Engineering Indicators. Chapter 5: Academic Research and Development—Data and Terminology. https://wayback. archive-it.org/5902/20150818094753/http://www.nsf.gov/statistics/seind06/ c5/c5s3.htm (last accessed 5 January 2017).

Shu, Fei, Vincent Larivière, Philippe Mongeon, Charles-Antoine Julien, and Andrew Piper. 2016. ''On the Evolution of Library and Information Science Doctoral Dissertation Topics in North America (1960–2013).'' *Journal of Education for Library and Information Science* 57 (2): 131–42. http://dx.doi.org/10.12783/issn.2328-2967/57/2/5.

Vickery, Brian. 1997. ''Metatheory and Information Science.'' *Journal of Documentation* 53 (5): 457–76. http://dx.doi.org/10.1108/EUM0000000007206.

Walters, William H., and Esther Isabelle Wilder. 2016. ''Disciplinary, National, and Departmental Contributions to the Literature of Library and Information Science, 2007–2012.'' *Journal of the Association for Information Science and Technology* 67 (6): 1487–1506. http://dx.doi.org/10.1002/asi.23448.

Wilson, Thomas D. 2002. ''Philosophical Foundations and Research Relevance: Issues for Information Research.'' Paper presented at CoLIS4: 4th International Conference on Conceptions of Library and Information Science: Emerging Frameworks and Method. http://www.informationr.net/tdw/publ/papers/COLIS4.html (last accessed 5 January 2017).

Wouters, Paul, and Rodrigo Costas. 2012. ''Users, Narcissism and Control – Tracking the Impact of Scholarly Publications in the 21st Century.'' Report for the Surf Foundation. http://research-acumen.eu/wp-content/uploads/Users-narcissism-and-control.pdf (last accessed 5 January 2017).

Yang, Kiduk, Jongwook Lee, and Wonchan Choi. 2016. ''Publication and Citations Patterns of Korean LIS Research by Subject Areas.'' *Malaysian Journal of Library and Information Science* 21 (2): 67–81. http://dx.doi.org/10.22452/mjlis. vol21no2.5.