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Information Science: The Canadian Context

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Article abstract

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INFORMATION SCIENCE: THE CANADIAN CONTEXT

Dietmar Wolfram and Clara M. Chu1

ABSTRACT

This study outlines the development of information science in Canada through an examination of the research contributions to the field by Canadians. Identification of contributors, their backgrounds and the sub-areas of information science to which they have contributed indicate that the field continues to draw inter-disciplinary contributions from a wide variety of academic fields. Despite the tenuous self-identity of the discipline, the development of Canadian periodicals as well as undergraduate and graduate education programmes devoted to information science indicate an increased recognition of the existence and validity of the discipline.

RESUME

L'examen des contributions canadiennes dans le domaine de la science de l'information permet de retracer de développement de cette discipline au Canada. L'identification des contributeurs, de leur formation et de leurs domaines de spécialisation met en évidence le caractère inter-disciplinaire des contributions à la science de l'information. Malgré une identité disciplinaire peu développée, l'apparition de revues canadiennes et de programmes d'enseignement à tous les cycles universitaires, indique que la science de l'information est une discipline dont l'existence et la légitimité sont de plus en plus reconnues.

Information science has been acknowledged as a field of study for the past thirty-odd years, but even today it is argued whether it constitutes a valid discipline with a distinct

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identity. Because of its relative youth and its amorphous nature, it has been largely unexplored as a topic of historical investigation. The field has now matured sufficiently such that an historical examination is warranted, and recently several such studies have been undertaken. Most of these papers2 have examined the emergence of the field and its antecedents in the United States and Europe, but a comprehensive examination of the development of the field in Canada is lacking.

The present study attempts to outline the development of information science in Canada through an examination of the published research contributions of Canadians. The study also hopes to identify the contributors to the field and their academic and professional backgrounds, the areas of research concentration and development and the publication sources for information science research by Canadians. Such information will ultimately be used to draw conclusions about the degree of distinction of information science as a field in Canada and its level of autonomy from other allied disciplines.

Debate has continued over the scope of information science for decades. Its interdisciplinary nature has made precise definition difficult, and it cannot be claimed that a universally accepted definition exists. The traditionally close relationship information science has shared with library science and computer science, the numerous changes in terminology over time, and the geographical preferences for term usage all serve to further complicate matters.3 The definition developed by Borko provides a broad overview of the purpose and scope of information science and suffices for the present study:

[Information science] is an interdisciplinary science that investigates the properties and behaviour of information, the forces that govern the flow and use of information, and the techniques, both manual and mechanical, of processing information for optimal storage, retrieval, and dissemination.4

2   For example, see Glynn Harmon, 'On the Evolution of Information Science,' *Journal of the American Society for Information Science* 22 (1971), 235-41; Saul Herner, 'Brief History of Information Science,' ibid., 35 (1984), 157-63; W. Boyd Rayward, 'Library and Information Science: An Historical Perspective,' *Journal of Library History* 20 (1985), 120-36; and Jesse H. Shera and Donald B. Cleveland, 'History and Foundations of Information Science,' *Annual Review of Information Science and Technology* 12 (1977), 249-75.

3   The term information science itself is not very old, having its first recorded usage listed in the *Oxford English Dictionary* as 1960. Areas of research eventually subsumed by information science have undergone various name changes since the turn of the century. For example, see Alvin Schrader, 'In Search of a Name: Information Science and its Conceptual Antecedents,' *Library and Information Science Research* 6 (1984), 227-71; and H. Wellisch, 'From Information Science to Informatics: a Terminological Investigation,' *Journal of Librarianship* 4 (1972), 157-87.

4   Harold Borko, 'Information Science: What is it?' *American Documentation* 19 (1968), 3.

This definition, like the many others which have been developed, provide at best a descriptive core for the field.

The amorphous nature of the field is largely due to its origins. Unlike most established science and social science disciplines, information science did not develop from a nuclear domain which then diversified into several branches. Rather, it coalesced from aspects of several existing areas of research, each of which dealt in part with what information science was to become. These disciplines included documentation, librarianship, and more recently, computer science, linguistics and the behavioural sciences.

One of the oldest, and perhaps the most influential antecedents to the field, documentation, can be traced back to the turn of the century. The development of documentation itself stemmed from bibliography late in the nineteenth century in Europe, when several bibliographers attempted to develop methods to identify all the scientific and technical literature being produced internationally.[5].

Accounting for all such published literature, even in the last century, proved to be a monumental task. The rate of publication of scientific literature had been growing exponentially for the past two centuries.[6] By the mid-nineteenth century it was becoming impossible for scholars to keep up with the flood of scientific and technical literature available. An organized, international effort to classify and collect such publications was necessary.

The resulting documentation movement was due largely to the Belgians Paul Otlet and Henri La Fontaine, the founders of the International Institute of Bibliography[7] in 1895. Otlet and La Fontaine attempted to improve access to these materials by creating a repository for scientific and technical information. A specialized classification system for such documents, the Universal Decimal Classification, which was more exhaustive than other classification systems available at the time, was devised for improved access to these materials.[8]

In the United States an organized documentation effort did not emerge until the 1930s and followed a different path of research. While the Europeans had emphasized a classificatory approach to document storage and dissemination, the later American effort emphasized the use of micro-reproduction technology for efficient and timely access to specialized documents. Microfilm technology had recently been perfected

5   Rayward, *op. cit.*, 122-3.
6   For an overview of the growth of scientific literature, consult Derek de Solla Price, 'Diseases of Science' in *Science Since Babylon*, enlarged edition, (New Haven, 1975), 161-95.
7   Now the International Federation for Documentation.
8   Rayward, *op. cit.*, 123.

during the 1920s and soon became more widely available for commercial use. Its use as an efficient and timely means for information storage and dissemination was quickly realized. Watson Davis of the Science Service agency in Washington, DC, spearheaded the American efforts in providing documentation services employing microfilm for document duplication and dissemination.9 The documentation services initiated by Davis commenced in 1934 and soon resulted in the formation of the American Documentation Institute in 1937.

Innovations in the design of manual information retrieval systems during the forties as well as in computer technology following the Second World War provided an important catalyst for the evolution of information science. Conceptual innovations for retrieval systems also provided impetus for research. Vannevar Bush's now classic paper 'As We May Think'10 outlined a conceptual personal information storage and retrieval system named a 'memex.' This prototype for a hypertext-based information system predicted for the near future, captured the imagination. Contemporary developments in information retrieval systems based on boolean logic retrieval, as opposed to traditional hierarchical systems, resulted in expanded research into retrieval systems, indexing methods for documents and associated linguistic issues.

Parallel to the development of documentation during the first half of this century was the development of 'statistical bibliography,' which concerns itself with the quantitative study of recorded discourse and its use. Works by Bradford, Lotka and Zipf,11 now regarded as key papers in the field, outlined regularities in the production and use of recorded discourse. These papers provided the foundations for what is now referred to as 'bibliometrics' in western countries and 'scientometrics' in eastern countries.12

The 1950s marked a time of synthesis for the various areas which today comprise information science. Structural changes in the American Documentation Institute during the early fifties converted the Institute into a professional organization, with individual memberships.13 Previously the Institute had been emphasized as a service organization with only organizational memberships for scholarly groups. The creation

9   Watson Davis, 'Project for Scientific Publication and Bibliography,' in J. D. Bernal, *The Social Function of Science* (Cambridge, 1939), Appendix VIII.

10   Vannevar Bush, 'As we May Think", reprinted in Manfred Kochen, ed., *The Growth of Knowledge* (New York, 1977), 23-35.

11   Reprints of the papers by S.C. Bradford, 'The Documentary Chaos,'; A.J. Lotka, 'The Frequency Distribution of Scientific Productivity'; and G. Zipf, 'The Form and Behaviour of Words' may be found in A.J. Meadows, ed., *The Origins of Information Science* (London, 1987).

12   A newer term, 'informetrics', coined within the last decade, attempts to unite the two terms and subsume their slightly different areas of concentration.

13   Claire K. Schultz and Paul L. Garwig, 'History of the American Documentation Institute--a Sketch,' *American Documentation* 20 (1969), 157.

of the journal *American Documentation* in 1950 provided an important forum for ideas and research in documentation.

A new term quickly emerged to describe much of the recent documentation research: 'information retrieval.' Innovations in computer technology during the fifties caused a shift away from microfilm based retrieval systems to research based on automated systems. Activities of the Institute began to focus on more effective means of bibliographic control with studies in classification and boolean-based indexing. Linguistic aspects of indexing and classification also began to be incorporated in research. The time period also saw the development of the first documentation courses in the curricula of American library schools.14 By the early sixties another term to describe the related research interests had emerged and was quickly embraced by researchers: information science. The increasing acceptance of the term by ADI members prompted a change in name of the American Documentation Institute to the American Society for Information Science in 1968.

In Canada the development and recognition of information science has occurred more slowly than in the United States. Although the time period initially undertaken in the present study has attempted to encompass the generally recognized existence of information science, it was found that Canadian research in the field was not widely undertaken until the early 1970s.

Education for information science in Canada has primarily been offered in the seven accredited graduate schools of Library and Information Science and in several departments of Computer Science in Canadian universities. Prior to the late sixties no library science programme officially recognized information science in their curricula. In 1965, the University of Toronto library school was the first in Canada to incorporate a course employing computerization. By 1970 all existing programmes had similar courses.15 The School of Library and Information Science at the University of Western Ontario, established in 1967, was the first school to specifically recognize information science as part of its curriculum.16 Several Computer Science programmes which have incorporated aspects of information science in their curricula, namely the University of Alberta, Queens University and the University of Guelph, have also contributed to information science education. The Computer Science department of the University of Alberta, beginning in the sixties, offered a specialization in information science within its undergraduate and graduate computer science degree programmes, with emphasis in the area of computerized information storage and retrieval. This limited

14 Shera and Cleveland, *op. cit.,* 255.
15 Jean Tague, 'Information Science in Graduate Library Programs,' *Canadian Library Journal* 23 (1979), 91.
16 By 1988 all seven of the graduate programmes in library science in Canada have incorporated 'information' in their names.

academic opportunity in information science until the seventies is perhaps largely to blame for the late start of information science research in Canada.

Prior to the late sixties, no Canadian forum existed for the publication of information science research. The few Canadian contributions to the field were published in American periodicals such as *American Documentation*, *Information Storage and Retrieval*, and especially *Proceedings of the American Documentation Institute*.17 Existing Canadian library journals were inappropriate in scope for such research, and only a small percentage of information science literature had been published in these journals.

In 1969, the recently formed Western Canada Chapter of the American Society for Information Science began to publish proceedings of annual meetings. Papers presented were largely of professional interest for those employed in the information industry. However, it did mark the first periodical in Canada dedicated to information science and it brought together interested parties from the schools of librarianship, departments of computer science and information professionals in western Canada.

The formation of the Canadian Association for Information Science in 1970 marked the first national and totally Canadian organization for information science, representing both academics and professional workers. Annual meetings with published proceedings, beginning in 1973, followed by the creation of the bilingual *Canadian Journal of Information Science* in 1976 provided new outlets for dissemination of research in Canada. In Quebec the library journals *Argus* and *Documentation et Bibliothèques* have served to supplement as a Canadian research base for francophone contributions.18

A comprehensive examination19 of the field and its development has been attempted in the present study through a collection, examination and categorization of informa-

17   Respectively now, the *Journal of the American Society for Information Science*, *Information Processing and Management* and *Proceedings of the American Society for Information Science*.
18   Francophone research has originated primarily from L'Ecole de bibliothèconomie et des sciences de l'information at the Université de Montréal. Consult Suzanne Bertrand-Gastaldy, 'Les activités de recherche à l'école de bibliothèconomie et des sciences de l'information", *ARGUS* 16 (1987), 3-8.
19   A general summary of the findings is presented here. A less historical and more in depth and quantitative study of the results can be found in Clara M. Chu and Dietmar Wolfram, 'An analytical Survey of Information Science in Canada,' to be submitted to *Library and Information Science Research*.

tion science research literature produced by Canadians.20 Before any interpretation of the literature was undertaken, a classification scheme containing the different areas of information science was developed (see Appendix A). The scheme was developed after examining the scope of existing definitions of information science, coverage of information science journals and abstracting services, as well as curricula in information science. Identification of contributors to the field was then required and was accomplished by scanning several sources. Faculty listings and areas of specialization of Canadian schools of library and information science were available for the period of study and identified those academics directly involved in the field. Identification of academic contributors from allied disciplines and non-academics proved to be more challenging. Available issues of key journals in the field and conference proceedings were scanned for Canadian contributions. Geographic searches of *Library and Information Science Abstracts* (*LISA*) also identified contributors to the field. *LISA* CD-ROM database searches for each of the possible contributors identified papers published by each person. As well, early references indexed in *Library Literature*, which included information science research papers, identified possible early references not covered by *LISA*.21

From the various sources, a list of 268 contributors to the field over the past twenty-five years was compiled. Bibliographic citations and abstracts of all papers of possible contributors were retrieved from LISA, but not all were considered to constitute contributions to information science. These citations were not included in the study. The final group of publications included in the study totalled 454.

Of the compiled list of contributors, more than half (160) had only published one paper singly or in combination with other authors. The distribution of author productivity, i.e. the number of papers per author, follows a negative exponential relationship, traditionally found in productivity studies. A breakdown of the known affiliation of authors indicates that the largest proportion of contributors are members of the academic community in library and information science, followed by professional librarians, professionals in industry and roughly equal representation from computer science/mathematics faculty, other academic disciplines22 and government employees.

A separate examination of the twenty-two prolific contributors (i.e. those who have contributed more than five papers to the field) indicates a slightly different distribution. The group consists of eleven contributors from faculties of library and information

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20 By 'Canadian materials' it is meant those which have been published in Canada by a Canadian citizen or resident, as well as materials published in other countries by Canadian citizens.

21 Publications included for consideration in the present study were limited to those indexed by indexing services which specifically include journals that publish 'information science' research. The authors recognize the possible parallel research being performed in disciplines such as management studies, which are indexed elsewhere, but these publications were not considered.

22 Other academic contributors to the field include researchers from the areas of education, engineering, journalism, law, and linguistics.

science faculty, nine from computer science/mathematics faculty, one faculty member from management studies and one professional librarian.

The development of Canadian sources of publication in information science does not appear to have significantly altered the relationship between the proportion of articles published in Canada versus those published abroad. Since the late sixties the proportion has fluctuated depending on the year, occasionally with a greater number appearing in Canadian periodicals than in American periodicals in some years. The average proportion having been published in Canadian periodicals is 30%. The number of Canadian papers appearing in non-Canadian journals has not decreased. However, the Canadian sources have provided additional outlets to handle the increased number of publications in information science by Canadian researchers. The *Canadian Journal of Information Science* has been the source of the second greatest number of Canadian papers in the field, closely following *Proceedings of the American Society for Information Science*.

An examination of the growth in the number of papers being published reveals that, an exponential growth of the field did occur during the late sixties and early seventies. This growth has since linearized by the mid-seventies, averaging twenty-eight papers per year (see Figure 1). The low observed figure of twelve papers for 1988 is a result of the lag time between publication of papers and their inclusion in *LISA*.

Dramatic shifts in the type of research undertaken do not appear to have occurred over time in the field, although new popular areas of research have emerged during the past twenty-five years.

Bibliometrics, a specialized sub-discipline within information science, has never constituted a large proportion of the research in the discipline due to its esoteric nature which has been often criticized for having few applications. Its relative contribution to the field has remained stable over time. The largest number of papers have dealt with bibliometric measures of information phenomena, with applications of bibliometric studies also constituting a considerable proportion.

The broad sub-area of indexing and classification, concerned with information organization and retrieval on a conceptual level, has been an active area of research in the field since the inception of information science. Its necessity as an effective means of retrieval makes it a fundamental component of any information system. Automation of such processes has been the dominant sub-area of concentration for researchers over the past twenty years. As key constituents of information retrieval systems, indexing and classification should continue to be an important topic of research.

Human factors in information studies has constituted a new area of research which has only emerged in Canada since the mid-seventies. Recognition of the importance of knowledge relating to the cognitive and behavioural processes behind the user of information systems and the human-machine interaction for interface design, as well as the trend towards end-user searching of database systems has made research in this

area one of the most productive. Because of its relative newness and productivity, it constitutes the fastest growing sub-discipline within information science.

Information storage and retrieval, like classification and indexing, constitutes the other fundamental area of information science research which together form the core of the discipline. It has accounted for the largest number of studies to date in Canada. Within this area, the design and evaluation of retrieval systems has comprised the largest concentration of research. The design of expert systems and aspects of artificial intelligence, although accounting for only a small percentage of the literature, has emerged as an important research area and should continue to grow due to its popularity in allied disciplines.

Information processes and social issues, an umbrella term used by the authors to cover several other areas of research (economics of information, scholarly communication, information networks, and education and research issues), has remained a stable source of publications until the last four years. Since the mid-eighties the area has produced fewer papers than in the previous decade. Studies in information networks have provided the largest number of research papers in this area.

The large percentage of contributions from researchers not directly associated with the discipline raises questions as to whether information science can be considered a valid and distinct discipline within the social sciences. Canadian criticism of the validity of the field is also evident.[23] This debate is of great concern to researchers in the field, who wish to justify the uniqueness of their research.

The 'non-social' component of information science, the development of automated storage and retrieval systems, clearly overlaps with research traditionally considered to be subsumed by computer science. When one takes into account by the inclusion criteria employed in the present study that nine of the twenty-two most prolific contributors have been affiliated with departments of mathematics and/or computer science, one would be hard pressed to deny the strong relationship. Likewise, the large contribution of professional librarians to the field draws attention to the strong ties information science has had and continues to have with librarianship/library science. The fact that in Canada academic programmes in information science, in all cases, are allied with computer science or library science academic units indicates, at best, a tenuous self-identity for information science.

Conversely, for a field which may not have any secure identity, its continued growth in terms of the numbers of publications being produced, the development of Canadian fora for such research as well as the increasing number of doctorates being produced

23   See Alvin M. Schrader, 'The Domain of Information Science: Problems in Conceptualization and in Consensus-building,' *Information Services and Use* 6 (1986), 169-205; and Louis Vagianos, 'Information Science: a House Built on Sand,' *Library Journal* 97 (1972), 153-7.

in the field in Canada leads one to believe that the field is showing a steady growth. The recognition of the move towards an 'information society' has made the role of the information professional increasingly necessary to the day to day operations of many organizations, thus further emphasizing the continuing role of such professionals. Whether information science does constitute a distinct discipline or not, it will continue to be a part of the Canadian academic environment.

This paper has attempted to outline the development of the amorphous discipline of information science in Canada since its inception. As a field of study information science has borrowed from various other established fields for its research methodologies, both from the physical and social sciences. Analyses of the Canadian research literature indicate contradictory findings as to the distinct identity of the discipline. The broad cross-section of backgrounds of the different contributors to the field indicates that a large percentage of contributors are researchers who would not be primarily classified as information scientists. This supports the hypothesis that information science is not a distinct discipline, but rather a sub-area within many existing disciplines. However, the development of Canadian journals in the field, as well as the steady increase in the number of papers being produced, would indicate that although at best ill-defined information science will continue to grow in Canada.

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APPENDIX A

Classification of Information Science

B00 Bibliometrics (General and Research Methods)
B01 Applications
B02 Citation Analysis
B03 Laws
B04 Measures

C10 Indexing and Classification (Research Methods)
C11 Indexing (General)
C12 Classification (General, Schemes)
C13 Abstracting
C14 Applications
C15 Authority Control/Controlled Vocabulary/Thesauri
C16 Automated Processes (Indexing, Translation, Editing)
C17 Bibliographic Control/Documentation
C18 Cataloguing
C19 Evaluation of Systems
C1A Linguistic Issues

H20 Human Factors in Information Studies (Research Methods)
H21 Applications
H22 Cognitive Processes/Cognitive Styles
H23 Information Seeking Behaviour (Use, Needs)
H24 Interface Design (Human-Machine Interaction)
H25 Online Searching/Query Negotiation

I30 Information Storage and Retrieval
I31 Information Storage (General)
I32 Information Retrieval (General)
I33 Applications
I34 Conceptual Models (Data Models, Retrieval Models)
I35 Expert Systems
I36 Modelling and Simulation
I37 Systems Analysis/Evaluation (eg. Recall and Precision)
I38 Systems Design
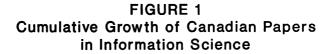
P40 Information Processes/Social Issues (Research Methods)
P41 Economics of Information
P42 Information Networks/Flow
P43 Scholarly Communication
P44 Sociology of Knowledge
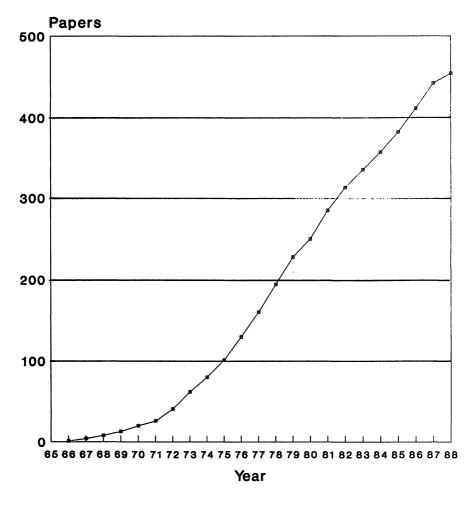P45 Education and Research
P46 Information Science (General)

Table 1. Canadian Publications in the Five

Information Science Areas

Field	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88
Bibl.	1				1		5	1		3	3	3		4	3	5	2	3	3	5	2	4	2
C & I		2		3	1		2	7	5	7	8	10	6	7	8	5	8	6	5	6	5	8	4
H.F.						1		1	1	1	3	2	5	7	1	5	7	5	5	12	10	5	2
IS & R		1	3		2	5	4	7	8	7	6	9	13	10	1	15	6	5	1	2	8	10	3
IP/SI			1	2	3		4	5	4	3	8	7	10	6	9	5	5	3	8		4	4	1
Total	1	3	4	5	7	6	15	21	18	21	28	31	34	34	22	35	28	22	22	25	29	31	12

FIGURE 1
Cumulative Growth of Canadian Papers
in Information Science

Papers

Year

—•— Series 1