Networked Collaboration: the emerging paradigm in information science

by

Morley Lipsett
(e-mail Morley_Lipsett@sfu.ca)

and

Peter Anderson
(e-mail Peter_Anderson@sfu.ca)

Centre for Policy Research on Science & Technology
Simon Fraser University
515 W. Hastings St.
Vancouver, BC V6B 5K3

Abstract

Rather than in the access it gives us to vast libraries of information, the fruits of information science are found, we suggest, in the unprecedented ways we find ourselves collaborating in our work. The old paradigm of information science—electronic delivery of information—is giving way to new embodiments of electronically-aided networked collaboration. We use some CAIS history, and two contemporary examples to illustrate.

CAIS history and introduction

Over a sixteen year period, CAIS has seen a remarkable transformation in the paradigm that governs the way people work together using the tools of information science. In 1978, at a CAIS annual meeting in Montreal, an invited paper described how a marvellous new computer system consisting of a minicomputer with remote access graphics terminals enabled the Ministry of State for Science and Technology to publish a science addendum coincident with the tabling of the Main Estimates[Lipsett, 1978]. The technical excitement of the day was the way in which tables, charts, graphs and trends could be generated by an on-line system that reflected departmental spending **intentions** in science and technology rather than stale spending **history**. Of course, what actually made the project work was the willing collaboration of a network of people at Statistics Canada, MOSST, the Treasury Board Secretariat, and many other departments and agencies. But at the time, the breakthrough appeared to be a technical one; and technology got the credit.

We now recognise that something important was happening under our noses. People were finding that computers were more than fast calculators; they were tools for linking co-workers in ways that enabled us to collaborate as social networks on topics of mutual concern. Thus the MOSST computer system was a

communication tool that linked many people from many departments who were concerned with science and technology policy and associated budgetary matters.

The technology of computers and their interconnections has developed at a remarkable pace. Nowadays everyone seems to have a PC on his or her desk, and many of them are connected via modems or LAN's to each other through the Internet or other technical nexus. But equally importantly, though possibly less visible, our personal connectedness has undergone a rich expansion. We find ourselves working as part of a web of collaborative networks. These networks build on the goodwill and mutual interest of other participants who belong as well to other collaborative networks. The new electronic networking technologies facilitate this process, but the fundamental change is in the widespread acceptance of interconnected interests and concerns of the people using the technology. We call this phenomenon "networked collaboration" to place the emphasis on society rather than technology, and suggest that this has become the new paradigm of information science. When the focus is on the technology, the paradigm switches back to electronic delivery of information, and the social dimension is masked or lost.

In this paper, we present two very different, yet representative examples to illustrate this blending of IS tools with social concerns to form networked collaborations. The first is the international network participating in and using

EPIX (Emergency Preparedness Information eXchange). The second is the provincial/federal network of organisations contributing to a British Columbia Census of Industry, Technology and Innovation (Industry Census).

The EPIX project is the more technical of the two, given its development under Internet. EPIX is an emergency management communication system. Its primary purpose is to facilitate the regular exchange of ideas and information in support of integrated disaster mitigation practices. It places members of the emergency management community in contact with each other and with relevant organisations and programs, providing them with background and operational disaster related information on both a domestic and international basis. EPIX also serves as an international experimental platform for the development and testing of new emergency communication and information management applications. In other words, EPIX brings together a group of people whose interests are in dealing with such emergencies and disasters such as earthquakes, volcanic eruptions, and other environmental surprises.

The second example, the BC Census of Industry, Technology and Innovation is less technical in nature, and only uses the tools of information science to amalgamate and redistribute data from a wide variety of databases. But, like EPIX, the tools of information science have made it possible for people of goodwill from many different government departments and agencies to collaborate in a project

that cuts across the interests of all of them. The technical aims of the census project are to obtain an accurate picture of industrial demographics in BC to improve the foundation for the design, development, implementation and assessment of science and technology policies, and to study the innovation process in industry. While this project is still in the early stages, the process of collaboration is shedding new light on the existence of a large number of previously invisible R&D performing companies, many of whom are developing new products and services in the field of information science.

Information science in disaster management

The application of information science, offers significant opportunities in integrating, co-ordinating and communicating information among emergency services. The need for such communication is especially critical where community emergency and social services are called upon to manage the effects of major hazard occurrences, whether their origins be natural, socio-technological or a function of the interaction between them. Canadians, for example, are not immune from such major hazards as:

- earthquakes, tsunamis, volcanic eruptions
- storms, floods, landslides and mud slides
- water supply emergencies
- forest fires

- diseases and epidemics
- gas/oilfield fires and leaks, mining accidents
- hazardous spills, discharges and emissions
- aircraft crashes

The emergency management community is often constrained in its response to hazard risk by a number of issues specific to information science[AEMI, 1993]:

- Copious information exists, but much of it is unavailable beyond the organisation compiling it.
- Many information systems have developed in isolation and without commonalty.
- There are no standards for information collection, classification, storage, processing and exchange.
- Provision of, access to, and cost efficiency in accessing information vary from one organisation to the next.
- No facility exists for the co-ordinated exchange of information.

These social and technical obstacles to effective communication are turning out to be an opportunity for the emergency management community. The newest tools of information science give emergency managers ways of benefiting from the massive investments being made in dissimilar provincial, national and international communication and information management infrastructures and services. We are

witnessing the gradual blending of private and public, commercial and non-commercial networks and services from all over the world[Anderson, 1992]. Computer-mediated networking is providing a means through which research and planning can be undertaken collaboratively, and/or results can be shared simultaneously by clusters of users all over the world. As such, these networks are helping to strengthen, expand the reach or establish new relationships among the practitioners, researchers, specialists, planners, and policy-makers concerned with the emergency management process.

EPIX at SFU

These technologies are being applied to emergency management practices at Simon Fraser University's Centre for Policy Research on Science and Technology (CPROST). The work brings other national and international organisations together to collaborate on the development of emergency communication research and applications. A geographically dispersed team is involved in the design, testing, evaluation and implementation of new electronic messaging, file and computing resource sharing systems, and has resulted in an emergency preparedness information exchange system named **EPIX**.

A prototype **EPIX** service is now available on-line at SFU for public use. EPIX is a computer-based emergency management information system operating

on the world-wide Internet. Its primary purpose is to facilitate the regular exchange of ideas and information in support of integrated disaster mitigation practices. It places members of the emergency management community in contact with each other and with relevant organisations and programs, providing them with background and operational disaster related information on both a domestic and international basis. In other words, it brings together those who have knowledge about hazards with those who have to deal with the hazards.

EPIX is available on a 24 hour per day basis from any personal computer or terminal connected to an Internet host which offers "gopher" or "telnet" service. Users can explore, search and retrieve information residing anywhere in the world-wide Internet system. The core program of EPIX is a typical "Gopher" server that takes advantage of the University of Minnesota protocol for network access to distributed menus, files, and other services over the Internet. Services are organised and accessed through a series of nested menus. The actual information provided via each menu or sub-menu may reside on the local EPIX host or on another information server located across the world. But from the user's perspective, all the items presented on the menus appear to come from the same place.

The initial development efforts have been to build specialised Canadian and international databases and information services, and to consolidate existing

Internet applications serving emergency/disaster management interests. Thus EPIX services include not only locally-based information and applications, but also services provided by others. These links form a web of interdependent knowledge building processes cutting across natural and social science disciplines, professions, government and non-government institutional arrangements and geographical regions.

EPIX also serves as an international platform for developing and testing a variety of new Internet-based services for emergency management. In addition, it serves as an electronic archive site for storing and facilitating access to information on behalf of other organisations, including the United Nations. Thus CPROST has technical and co-ordinating roles in the collaboration, but others have comparable roles and are making equally important contributions. Some of these organisations are as follows:

- The UBC Disaster Preparedness Resources Centre,
- The Natural Hazards Research and Applications Information Center, University of Colorado
- The Earthquake Engineering Research Centre at the University of California - Berkeley
- The California Governor's Office of Emergency Services
- Volunteers in Technical Assistance, Washington, D.C.

- The Australian Disaster Management Network and the Victorian Institute of Forensic Pathology, Melbourne, Australia
- The Asian Disaster Preparedness Center, Asian Institute of Technology Bangkok, Thailand
- The United Nations Department of Humanitarian Affairs, Geneva
- The United Nations Development Program, New York

The information is provided in many forms, including text and binary data, directory information, images and sound. Services currently include information about:

- emergency and disaster management organisations
- emergency communication, training and research programs, specialised information services, natural and technological hazards
- upcoming conferences and events
- on-line discussion groups, libraries, newsletters and databases (including weather forecasts and recent seismic reports)
- disaster situation reports

Current users include individuals, members of universities and research centres, government and private non-profit agencies, corporations, civilian and military organisations, schools, and international agencies. As an example of the variety of interests served, a local group of planners uses EPIX to discuss the risk that

volcanic ash poses for aircraft. The group consists of federal and provincial emergency management co-ordinating organisations, police, meteorologists, vulcanologists, seismologists, and aviation experts.

EPIX recently helped to disseminate up-to-the-moment information about California wildfire and Los Angeles (Northridge) earthquake relief and recovery operations to thousands of individuals and agencies . In a single day, EPIX received some 1400 connections from around the world. During these operations, thousands of connections were made from all continents. In a similar manner, EPIX currently distributes international disaster situation reports, in the form of electronic mail, to selected sites world-wide on behalf of the United Nations Department of Humanitarian Affairs-Geneva.

Plans are being made to extend this work to support two specific UN initiatives: (1) promotion of and direct support for International Decade For Natural Disaster Reduction activities and (2) the development of a new International Emergency Readiness and Response Information System. On the domestic front plans are underway to develop a regional version of EPIX for British Columbia.

We do not know what all of this will accomplish, but we do know that the convergence of social concerns with the tools of information science are producing a transformation in the way emergency planners are working together.

Information Science in Science Policy

Our next example is less technical, takes place in a distinct geographic region, but nevertheless shows how information science enables unprecedented collaboration when people of goodwill agree to work together. We refer to the BC Census of Industry, Technology and Innovation. This is a project that involves many different organisations in BC, each of which "owns" a partial picture of BC industry. It consists of putting the pieces together to arrive at a comprehensive picture while still respecting the limitations and restrictions of the data of the individual agencies.

The project arose from widespread interest in the consequences of Canadian science and technology(S&T) policy. A frequent policy theme is to encourage industrial development and technological innovation to achieve increased international competitiveness, a theme that is at the forefront of modern economic growth theory[Lipsey, 1993]. It turns out, however, that Canada, like many other countries, does not really have an accurate measurement of the population of Canadian industries involved in S&T and innovation. The actual industrial landscape is a questionable picture. There are estimates and compilations, but few observations based on a direct encounter with a known majority of such firms. This project seeks to remedy the gap by enumerating the majority of industrial firms offering science and technology based products, processes or services.

The work is being co-ordinated by the Innovation Metrics Policy(IMAP) program, which, like EPIX, has its home at CPROST. The IMAP research program has found evidence to show that R&D in Canadian industry is understated and mischaracterized by a substantial margin[Lipsett, 1993]. The conventional view, which is frequently perpetuated in the media and by scholars who quote the same figures, is that Canadian industry is both non-innovative and remarkably low on international scales of R&D performance. However, this conclusion is based on a limited sampling of Canadian industry.

But another story is beginning to appear. Sometime after 1986, Canada's tax incentive program began to provide evidence that the industrial R&D community is much larger than generally recognised, particularly in the case of newly emerging firms in such fields as information technology. For instance, Statistics Canada reported that there were 3,459 R&D performing industrial firms in 1990, yet Revenue Canada received claims from more than 5,391, and saw evidence for the existence of many others. These discrepancies did not arise because of definitional differences. Both agencies use comparable definitions of R&D and employ careful verification techniques.

The BC Census of Industry, Technology and Innovation

Though we speak of an industry "census" we do not plan to conduct a door-to-door survey as if for a population census. Several industry registries of BC

companies already exist. They were constructed over the years to meet the operational needs of a variety of government agencies, industry associations, and commercial ventures. The best were created by operational agencies whose personnel maintain direct contact with each one of the entries. They exist in many different formats and contain a mixed collection of data for each entry. Each was developed as a job-specific tool to communicate and maintain a working relationship with "client" companies.

All of the same problems and constraints specific to information science in the case of the emergency management community apply equally well to this example; unavailability of information, incompatible information systems, lack of standards, access restriction, absence of mechanism for co-ordinated information exchange. But these social and technical obstacles are likewise turning out to solvable. The tools of information science are now enabling many groups to collaborate on building a new foundation for science and technology policy studies.

The opportunity is to obtain an accurate picture of the population and characteristics of technology based industry by amalgamating these databases to yield, in principle, a baseline registry of target companies. The social challenge is to obtain the co-operation and collaboration of the database owners. The technical challenge is to bring the information up to date and to eliminate duplicate entries.

Some ingredients for success are as follows:

- the co-operation of field personnel who can interact knowledgeably with the companies
- protection of certain information that the companies and or the agencies would not want divulged
- minimum irritation to the target companies

The objective is to obtain current information about the numbers of such companies, fields of science and technology involved in their work, products and services, employment characteristics, and, most importantly, whether or not they are investing in activities that are characteristic of R&D.

Work is now underway on this project, and many agencies have agreed to participate. The census is limited to British Columbia in the first instance but could serve as a pilot study for a more extensive national investigation. Key provincial and federal agencies operating in BC have agreed to contribute their databases and collaborate in the work. The project is designed around partnership contributions of one or more of the following ingredients;

- database access,
- in-kind staff time to update the information,
- knowledge of a specific part of the community,
- participation in an ad hoc interagency co-ordinating committee,
- money,

- technical assistance, and
- other contacts.

Each of the contributors is at the hub of an extensive network of industrial contacts, and deals with an overlapping subset of technology based industrial firms. We are in the process of linking these agencies, capitalising on their relationships with their specific client base, and obtaining, for the first time, a direct enumeration and collection of data about the population and technical characteristics of industrial firms and the R&D community in BC.

The enumeration of such companies entails a complex web of interactions between many people in many organisations. The contributing agencies, and the co-ordinating mechanisms will ensure that the quality of the enumeration will meet high standards. Personal contact will be used to verify the existence, employment and technical activities of each company in the database. CPROST is providing project co-ordination, technical support, consolidation, redistribution, and analysis. Contributing agencies will use their existing network of contacts to verify the accuracy of the entries for their "client" list, and will specify any access restrictions stipulated by their clients and other requirements for confidentiality.

The technical and social problems of this project stem from the need to merge numerous data bases residing in many forms in a wide variety of computer systems, to identify and remove duplicate records, and to verify, update and obtain

additional data on many thousands of organisations—and to do so with a minimum of disruption to the companies.

Eight organisations have supplied us with ten databases in a variety of formats and from a variety of platforms. We have had to become adept at reading, merging and updating every one of them. The results to date have been surprising. We began with the expectation of identifying perhaps 6,000 technology based companies in BC, and with the further expectation that most of the companies would appear on most of the databases. At an early stage in the aggregation, there were over 22,000 records, which included a substantial number of duplicates within a single database. We proceeded to use a variety of procedures to eliminate the duplicates, clean up the merged database, and prepare for the data verification stage. In the process, we ended up with close to 13,000 entries. Contrary to our expectations, comparatively few of the files submitted by each contributor was shared by any other contributor, even though all of the contributors are concerned to some extent with the same population of companies. These results are shown in the following table.

Database	Type of contributor	# companies unique to contributor	of	% unique
Contributor 1	Provincial agency	4,753	7,091	67
Contributor 2	Provincial agency	641	1,805	36
Contributor 3	Federal agency	2,576	4,334	59
Contributor 4a	Provincial agency	151	499	30
Contributor 4b	Provincial agency	132	291	45
Contributor 5	Industry association	181	514	35
Contributor 6a	Federal agency	17	230	7
Contributor 6b	Federal agency	258	834	31
Contributor 7	Public directory	742	2,686	28
Contributor 8	Industry association	56	155	36
		9,507		73

Number of companies in aggregated database: 12,959

The merged list is neither current nor complete, but it does indicate a totally different size of the industrial community than previously reported. It is too early to estimate the number of R&D performing companies within this total.

Contributors

Many organisations in the BC science and technology community are contributing to the BC Census of Industry, Technology and Innovation in the ways outlined above. We list them to indicate the extent of the collaboration in the community, but not to suggest that any of them are responsible for mistakes committed by the authors of this paper. The team of contributors consists of BC

Tel, Dynapro Systems, Science Council of BC, Ministry of Employment and Investment, National Research Council/IRAP Program, BC Advanced Systems Institute, Revenue Canada, Industry Canada, BC Trade, BC Biotechnology Alliance, Vancouver Island Advanced Technology Centre, and the Social Sciences and Humanities Research Council of Canada.

Concluding remarks

We suppose that everyone involved with information science has similar experiences. Perhaps we are pointing to the obvious with our examples. But perhaps it is worth underlining that a) people are predisposed to collaborate on issues of mutual concern, and b) the new tools of IS are conducive to collaboration. The emerging paradigm reflects the convergence of these phenomena.

References

Anderson, Peter S., Disaster Mitigation in the Age of Distributed Networking: The Development of an Australian Disaster Management Information Network - Project Overview, CIRCIT Research Report No. 3, Centre for International Research on Communication and Information Technologies, Melbourne, June 1992.

Australian Emergency Management Institute Working Group 1612 - Distributed Networks, Project EMNET: Emergency Management Network, Australian Emergency Management Institute, Mt. Macedon, 26 October, 1993.

Lipsey, R. G. (1993). Globalisation, Technological Change and Economic Growth, Annual Sir Charles Carter Lecture, Northern Ireland Economic Council.

Lipsett, M. S. (1978) Information Science and Science Information in the Federal Budgetary Process, CAIS annual meeting, Montreal.

Lipsett, M.S. (1993) Conversations about Science Policy, presented at the Inquiries on Social Construction Conference, University of New Hampshire, 1993.