A PERSPECTIVE ON FUTURE USERS' NEEDS IN FIRE SERVICE POLICY RESEARCH

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Abstract

As fire service management increases in its sophistication and with continued diffusion of technology and performance-oriented management paradigms, traditional library research needs will change. This combination of advancing technology and more incisive analysis of fire policy creates the need for new types of resources and presents opportunities for fire science librarians to enhance their role in providing necessary information and promoting its use in analysis of fire service and fire policy concerns generally. Among the technologies that will be discussed are geographic information systems (GIS) and web-based information dissemination. The management-related information needs include linkages to other disciplines and collection of performance data for fire services.

INTRODUCTION

If one assumes that fire service management and policy makers are getting more adept at producing desired service outcomes, or at a minimum that they are being held increasingly accountable for the consequences of their actions by elected officials and the public, then we can argue that fire service managers and policy makers are increasingly sophisticated. This increased sophistication can be subsumed under the general label of "the new public management" or "reinventing government" (Frederickson, 1996). While one can argue that this is an optimistic view and that fire service management has not materially changed, it represents a likely direction of change and could therefore be viewed as a "best practice" to be emulated by others.

The second major issue impacting on libraries is the advancing technology. As technology changes, methods of delivering information and the nature of collections has changed. These changes will likely increase the distance utilization of library resources and in effect allow the delivery of information to a far-flung group of users who previously were unaware or unable to access information from any but their local library or had to rely on the relatively cumbersome process of interlibrary loan systems.

These two developments in society and the fire services have created a need for a "change-oriented" library collection and means for dissemination. This change-oriented collection will be used to facilitate adoption of best practices and place a broader range of information before the policy makers than may have been done previously. A major challenge for librarians will be how to provide access to or "distilled" versions of this information while keeping focused on core issues of acquiring and making available the latest and best research and information for and by fire professionals.

TECHNOLOGIES AND THEIR IMPACT ON FIRE SERVICE RESEARCH

Two real and related trends in computing and communications have made a major impact on fire service research and will continue to transform both libraries and types of information needed by the clients they serve. These technologies include GIS and the World Wide Web (WWW).

World Wide Web

The World Wide Web (WWW) has already experienced tremendous growth as a means of delivering information to end users. While the WWW has enabled producers of information to deliver their results direct to consumers, there still remains a critical need for libraries and institutions. These entities play a critical role in acting as arbiters of technical quality. This role is especially critical in emerging areas of research for which end users my not be completely qualified to evaluate the veracity of data or quality of claims themselves.

The delivery of documents via the WWW enables users to access information without regard for distance or time. The recent emergence of extensive on-line document delivery has considerably eased the barriers to delivery of information, but raises a new set of questions about the role of libraries. As an instructor, I find the availability of documents on the WWW are valuable in terms of saving paper, enabling simultaneous access to information, and insuring that the most recent material is utilized.

The WWW is also being enabled by software that enables users to access other computers, databases, and graphics without the need to purchase or download software. This will prove increasingly important for promoting access to online catalog systems, graphics-intensive applications, and remote computers. The questions of access are quickly moving from the technical to the policy realm. such as Java that allows users to run complex programs without actually downloading the software. Without a right of ownership, are there adequate incentives to promote the placement of more resources on the WWW?

Geographic Information Systems (GIS)

Computing power has grown exponentially, and as a consequence, more analyses can be conducted on a personal computer than were previously possible. The availability of powerful computer software and computer processing power has tended to outstrip the sophistication of prevailing analytic methods for fire services. This has thrown into relief the limited state of knowledge of many of the fundamental questions of fire service delivery and the questions of balancing resources to achieve the greatest impact on fire losses in a community or nationally.

Principal among the new technologies that have revolutionized the potential for fire service deployment analysis are geographic information systems (GIS). GIS can be defined as “a number of spatial routines laid over a standard relational data base management system” (Huxhold, 1991, p. 28). GIS are becoming more user-friendly, but, like any powerful tool, require a great deal of thought before they can be used for complex and insightful analysis.

GIS is a tool, and its potential is only recently begun to be realized. GIS works with a set of base data which usually consists of base data stored in databases. This base data typically includes street information, property and tax information, census data (including socioeconomic, demographic, and building stock information), and locally obtained data such as location of infrastructure elements such as fire hydrants, standpipe connections, cisterns, hazardous materials, structural or natural hazards, mobility-impaired occupants, etc.

This base data stored in databases is supplemented by mapping capabilities of the GIS software that enables this information to be expressed visually.

According to GIS industry experts, as GIS grow in popularity, there will be three distinct classes of users. First will be the casual user (firefighter or company officer) who may wish to perform simple queries and see maps of features of interest such as fire hydrants in relation to a specific structure. The second level of user(s) will be professionals using GIS, consisting of command officers at the policy level doing sophisticated queries and analyses of geographic data. Examples of this level of analysis might be identifying patterns in fire cause analysis or selecting neighborhoods for public fire safety educational interventions. The third level of user(s) would be defined as the GIS professional. GIS professionals can be found in fire organizations and in supporting agencies such as municipal assessor's or engineers' offices and in institutions such as libraries. GIS professionals are distinguished by the fact that they develop and implement the addition or modification of data sources to a GIS system. This level of user would include researchers and a few key personnel in a governmental GIS department (ESRI, 1999).

In addition to these levels of conscious interaction with GIS is the growing presence of GIS embedded in other applications such as computer aided dispatch systems and wayfinding components of corporate web sites or freely-available services on the internet, some of which will provide turn-by-turn directions and maps given a starting and ending address.

As computing power has grown, the potential to deal with a greater number of data points while doing an analysis has also grown. GIS allows the user to go down to the individual structure, or given the data, the individual dwelling unit in terms of gathering and analyzing information.

Finally, the ability to access GIS information over the internet is a major advance that can potentially revolutionize the ability of fire services to improve the effectiveness of their operations. From the standpoint of the casual user, GIS and WWW will become one tool. For providers of GIS information, the WWW can be an affordable and easily accessible means for disseminating information.

THE CHANGING MANAGEMENT PARADIGM

Reinventing Government

Parallel with these technological changes are changes in the nature of public administration. The persistence of fiscal scarcity at the local government level and increased drives for accountability in government have drawn the fire service into the realm of greater oversight. This change in management paradigm has been popularly described as "reinvention" or the "new public administration." This paradigm was crystallized by the release of Osborne and Gaebler's *Reinventing Government* and the adoption of this theme at the federal level in the National Performance Review (Gore, 1994).[1]

This movement, while its effects and definition are contested, has brought increased attention to the fundamental ideas that public organizations should be accountable for results. Unfortunately, results are usually measured in terms of outputs (such as response times or numbers of inspections) rather than outcomes

[1] I consider the recently-popular "customer service" approach to managing fire services to be a misapplication of Osborne and Gaebler's main thesis. Alas, this is best considered in a separate paper.

(fire loss). With some interesting exceptions, fire services are still operating at this level of sophistication with regard to performance measurement (Finder, 1999).

Barriers to Greater Accountability

One of the key issues frustrating attempts to hold fire services accountable for outcomes is the start lack of knowledge concerning the effects of fire service expenditures on fire losses. The most basic questions of staffing, deployment, balancing resources between prevention and suppression, and built-in protection and code enforcement remain unanswered. In fact, since the downsizing of the United States Fire Administration in the early 1980s, almost no federal effort or funding has been directed at these questions.

Unfortunately, the lack of understanding of basic fire service delivery issues in not a new problem. This is not a trivial issue. The 1961 report of the National Academy of Sciences succinctly describes the fundamental difficulty in achieving fire policy research.

> The problems of fire suppression and fire prevention have been under study for a great number of years by a wide variety of private and governmental organizations . . . However, most of this effort is applied work, a good deal of which is directed toward the problems of satisfying code requirements and finding remedies for very specific problems. In addition, because the effort is supported by a wide variety of organizations, the direction of total effect is diffuse, and areas of economic interest to the whole nation are often of insufficient interest, to any one group, to produce a desirable overall level of attention (National Research Council, 1961).

One could argue that the situation hasn't improved considerably on questions of service levels and effectiveness in the last almost 40 years.

In addition to this development, a strain of regulatory control of local fire services has firmly established itself. Consensus standards and federally applied standards in the health and safety realm, despite good intentions, have added to the pressure on fire service organizations to perform. It has been argued that these efforts at regulation, accreditation, and standardization are being pursued in advance of adequate theoretical understanding of the complexity of the issues involved or the possible unintended effects of regulation (Falkenthal, 1999, p. 32).

A base of evidence and analysis is lacking from recent efforts to impose a deployment standard on the fire service in the proposed NFPA 1200, *Standard for Organization, Operation, Deployment, and Evaluation of Public Fire Protection and Emergency Medical Services*. After engendering considerable controversy and resulting in an impasse within the committee, the NFPA withdrew the standard. However, rather than shelve this effort until some consensus could emerge on the deployment needs, the NFPA elected to reconstitute the project as two different standards -- one for career departments and another for volunteers. They argued that despite the calls to stop work on standard, "deployment is an appropriate and deserving subject for standards development" (NFPA, 1998).

This combination of greater accountability and increased regulation makes the task of providing fire services more challenging for the fire administrator. For elected officials and city managers who ultimately assess the effectiveness of fire service management, measuring performance can be difficult. In the absence of a clear understanding of the precise consequences of tradeoffs between alternate fire safety

strategies, we are left to give it our best guess, relying on common sense and an understanding that diminishing returns are likely to be evident in fire service expenditures (Czamanski, 1975, p. 29).

Role of Libraries in Facilitating Fire Service "Reinvention"

Libraries must play a vital role in assisting the fire services to become more responsive and better managed. Making this transition from outputs to outcomes is challenging, but can be done, even without an overall nationally-focused research effort. Librarians can facilitate this process of "reinvention" by becoming suppliers of performance information or benchmarking information from departments across the country.

By providing access to response times, demand for service, and fire loss information at the community level, decision makers will be better informed when setting performance objectives for fire services. The International City-County Management Association (ICMA) has an ongoing effort to measure performance of municipal services, including fire. This effort has taken some early steps toward disaggregating the community's fire problem by examining the effectiveness of inspection programs and losses by occupancy type (ICMA, 1999).

FUTURE NEEDS

As the fire service begins its transformation into a more sophisticated producer and user of information, there are several areas that will likely receive increased attention. These areas are listed, followed by some suggested recommendations for action or identification of needs. As we will discuss in the following sections, GIS is central to many of these emerging research areas.

Performance Measurement

Performance measurement is the process of collecting data on the outputs (5.3 minute average response time) or outcomes (lives saved) of an agency and comparing them to the inputs (budget, staff, etc.) with consideration of the environment being served. As discussed in the previous section, performance measurement will be one of the key concerns in holding the fire service accountable. Initial efforts underway are limited, and need to be expanded to greater numbers of fire departments. The library need is to develop and disseminate databases of performance information at the national, state, and local level on basic information as suggested in the ICMA's Performance Measurement Project. This is a necessary but not sufficient step in advancing our knowledge of the fire problem and its management.

Community risk assessment

Another key research area will be community risk assessment. There are several ongoing efforts related to defining and measuring community fire risk at the small-area level. Community risk assessment forms the basis for deployment analysis, and relates directly to targeting public fire education campaigns. GIS systems can be used to deal with the vast array of data available to measure fire risk. These data include assessor's data on building age, dimensions, and construction type, census data, fire incident records, and can include locally determined data on occupant characteristics or behavior obtained from surveys or other means.

GIS allows an empirical analysis of community fire risk at the individual property level. This data can be used to develop performance criteria for community fire loss, permit prediction of demand for service based on new or planned construction, and when sufficient data are collected, comparison of fire losses between

communities (Jennings, 1998). The first study of this type was conducted in the 1940s for Oakland and Berkeley, California (Simon, 1943).

Table 1 lists fire risk on a per/building basis by major use category for Memphis, Tennessee from a previous study. In Table 2, fire risk is considered by use category, but by square footage of built area. This method of presenting data provides an alternative method for calculating fire risk, and reveals differences in fire risk. Normally, fire risk is expressed solely in terms of the human population (fires per unit population).

Table 1: Fire Risk per Building by Major Use Categories, Memphis City

Use Category	Number of Buildings (Assessor's Records)	Number of Buildings (Total)	Fires	Fires per Building per Year
Residential	162267	166048	4991	0.010
Commercial/ Industrial	9829	9911	675	0.023
Agricultural	0		0	
Institutional	492	492	95	0.064
Education	77	790	97	0.041
Hospital	267	359	49	0.061
Government	4	122	6	0.016
Total	172936	177722	5913	0.011

Table 2: Fire Risk per Square Foot by Major Use Categories, Memphis City

Use Category	Square Footage of Buildings in Memphis City (Total)	Fires	Fires per Building per Year per 1,000 square feet
Residential	284,247,545	4991	0.0585
Commercial/ Industrial	116,256,748	675	0.0194
Agricultural	0	0	
Institutional	2,881,718	95	0.1099

Education	23,099,890	97	0.0140
Hospital	17,777,183	49	0.0092
Government	2,085,493	6	0.0096
Total	446,348,577	5913	0.0442

GIS permits us to deal with a complete enumeration of the building stock being protected, thus offering the potential for more narrowly or even individually-determined risk profiles for each structure in the area to be protected. This type of analysis provides potential insights into the actual demand for services. When used in conjunction with socioeconomic data, it offers potential for great insight into the nature of a community's fire problem.

Public fire education

If fire services are serious about public fire education, GIS can be used to simultaneously evaluate building stock, occupant, and fire incidence data to target public fire education campaigns or identify fire problems that would otherwise go unnoticed. This can be especially useful in determining areas that should receive attention for personal outreach and as means for assuring that the greatest number of the target population (for example, children in high-rise apartments without sprinklers) is reached.

Deployment analysis

As an extension of community fire risk analysis, GIS can be used to site personnel and equipment for firefighting and emergency medical services. Rather than simply shading areas on a map that can be reached within desired time limits, studies of actual response contours can be produced. For example, the relationship of availability of companies to response times can be illustrated. GIS also permit evaluation of times to assemble a pre-determined complement of apparatus and personnel at certain locations based on their risk level.

Other uses of GIS in deployment analysis are in calculating driving times along the local street network, validating run card assignments, and in making calculation of population reached within response time guidelines.

Consolidation of services

As communities attempt to achieve greater efficiency in the provision of fire services, consolidation is another major issue that will receive increased attention in the future. The increased demand on fire service managers and the need to consider the cost-effective ways to provide necessary service levels will lead to greater emphasis on consolidation studies. Existing systems of apparatus, staffing, and stations are seldom optimal, and GIS can be used to identify areas of overlap and assess realistically the potential demand on proposed stations.

The Library Needs

As access to geographic data increases, fire science libraries will serve an important role in introducing this data to the fire service. Serving as filters to identify the best locations for information and acquiring basic introductory materials to explain GIS to researchers and decision makers will be important.

Most libraries have web pages, and these pages should include annotated links to reputable sources of data that are featured prominently and promoted to users. Many libraries are already doing this, and it should be continued. It is important to distinguish between scholarly versus trade sites, or organizational versus "objective" data in organizing these links.

GIS in analysis of fire services is in its infancy. Applications for fire service analytic purposes is almost unheard of. As a consequence, libraries can serve an important function by acquiring "best practice" data and analyses undertaken by other innovative fire service organizations and making it available to those beginning to work with this new technology.

CONCLUSIONS

Libraries play an important role in promoting improved service delivery through analysis of the local fire problem. As technologies change and fire service managers are under increased pressure to perform, libraries must provide needed information to support organizational transformation.

As information access via WWW and use of technologies such as GIS spread throughout the fire service, libraries must remain conscious of the need to serve users at all levels and promote dissemination of information by making data sets available for download over the internet; providing accessible copies of "best practices' reports on methodological or evaluation studies of current issues, and acting as conduits to place cutting edge information into the hands of the library user, both on site and remotely.

Perhaps libraries could begin by collecting these documents and making them available in electronic format. Since many of these documents are in the public domain, this should not be a major burden. Collaborative efforts to assemble and disseminate reliable data to be used in performance measurement studies and evaluation of public fire education programs should also be encouraged.

As the field of fire policy research grown increasingly interdisciplinary and sophisticated, the need for inFire and the role it plays will grow in importance. Partnering with major fire organizations, foundations, and government agencies to secure funding to support these efforts in a coordinated way should be encouraged.

The librarian is a change agent -- we must have the courage to challenge the status quo and set an example for the fire service of tomorrow. This is in keeping with our collective goal of rationally applying technology and analysis to determine the optimal deployment of resources to have the greatest effect on reducing the toll of lives and property lost to fire.

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BIOGRAPHICAL SKETCH

Charles R. Jennings, Ph.D., AIFireE is Assistant Professor of Public Administration and Fire Science in the Department of Public Management at John Jay College of Criminal Justice of the City University of New York (USA). He has a Ph.D. in City and Regional Planning and Masters degrees in Fire Protection Management and City and Regional Planning. Over the past ten years, Jennings has also consulted on fire service policy and management issues across the United States. This consulting has included working on national fire safety public education campaigns and major fire investigations on behalf of the United States Fire Administration.

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