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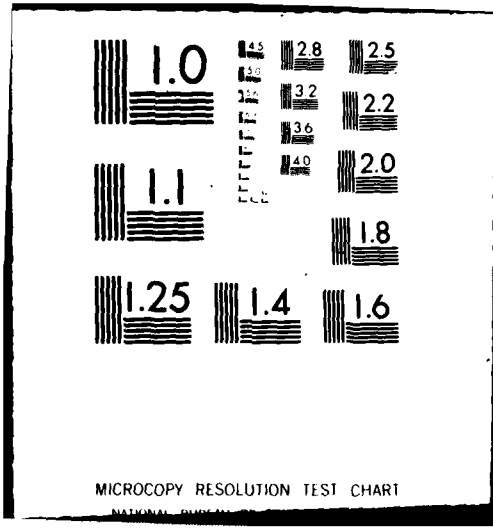
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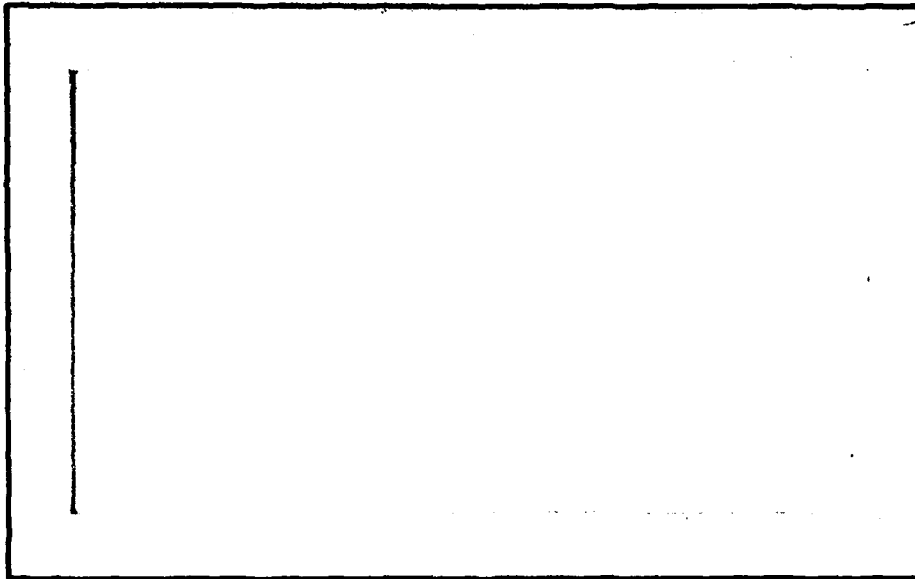
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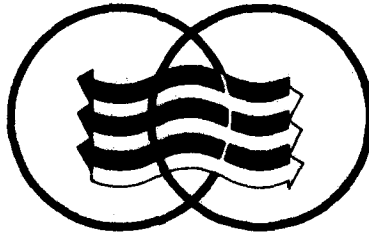
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Environmental Protection Service, seeks to better understand patterns of STI acquisition and sharing and information channel preferences among users of STI.

It was hypothesized that three clusters of variables would have predictive value in respect to channel preference and "gatekeeping": Job Perceptions, Administrative Role, Professionalism. The chief findings can be summarized as follows: (1) Preference for formal channels is associated with a low opinion of co-workers, increased age (independent of administrative responsibility) and high perceived utility for STI; (2) Preference for informal channels outside the organization is associated with membership in professional organizations; (3) Gatekeeping is associated with a low opinion of co-workers, doctoral-level degree, high attendance at professional meetings, and specialization. The implications of the findings for designing scientific and technical information systems are discussed.

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Public Managers
and
Scientific and Technical Information

ABSTRACT

Despite a tremendous influx of information into public agencies, and a concern with information processing models of organizations, there is a special variety of information that is often poorly utilized or underutilized -- scientific and technical information (STI). This study of public managers' orientations toward STI, a study based on data gathered from questionnaires mailed to officials of the Canadian government's Environmental Protection Service, seeks to better understand patterns of STI acquisition and sharing and information channel preferences among users of STI.

It was hypothesized that three clusters of variables would have predictive value in respect to channel preference and "gatekeeping": Job Perceptions, Administrative Role, Professionalism. The chief findings can be summarized as follows: (1) Preference for formal channels is associated with a low opinion of co-workers, increased age (independent of administrative responsibility) and high perceived utility for STI; (2) Preference for informal channels outside the organization is associated with membership in professional organizations; (3) Gatekeeping is associated with a low opinion of co-workers, doctoral-level degree, high attendance at professional meetings, and specialization. The implications of the findings for designing scientific and technical information systems are discussed.

Public Managers and Scientific and Technical Information

The hue and cry about "information overload" has not prevented public managers from arguing that inadequate or insufficient information is a major factor in poor planning and decision-making. One interpretation of this apparent inconsistency is that public managers are naive rationalists. According to this argument, public managers are bound by cognitive prisons of their own making: instead of acknowledging that very little information exists that might drive decisions, they fall ready victim to inertia by accumulating and sifting through streams of irrelevant information.

There is an alternative explanation of the ambivalence of public managers toward information resources. Public managers ingest a prodigious amount of information, but their information diet is unbalanced. They are often bloated with certain types of information (some of which may be useful, much of which is not) while being starved for others. To be more precise, information of an uncomplicated descriptive nature -- information that can be easily collected, coded and stored in archives or computer files -- is readily available and is usually cheap (especially if economies of scale are involved and computer technology is available). For want of a better term we can refer to this type information as "simple". Information about such matters as client/social worker ratios, units of goods or service provided, average annual rainfall, unemployment rates for the month of April, or number of vehicles registered are examples. This type information is "data" in the strictest sense: coded, discrete observations.

Another broad category of information can be referred to as "political information". Political information tells us about preferences, perceived self-interest and power resources of stake-holders (clients, other public managers and public officials, organized interests, etc.).

Political information is sometimes scarce because it is highly changeable, easily misinterpreted and disclosure may be against the interests of relevant parties. The public managers' lament ("If only I had more information!") often can be interpreted as a desire for additional political information.

A third category, "expository information" provides an explanation for some real or anticipated state of affairs. The explanation may be exact or approximate, true or false, rooted in evidence or intuitive. It is often stated in "if, then" terms and usually implies or seeks to shed light on causality. Our concern here is with a special kind of expository information that is often poorly utilized or underutilized in public agencies -- scientific and technical information (STI). In other words, we are concerned with explanations that are drawn, either directly or (more commonly) indirectly from knowledge produced by physical and social scientists.

If we define STI as "knowledge produced by scientists employing scientific methods in search of generalizations (theory)" it becomes clear why this particular variety of expository information is in short supply in public agencies. Typically, the producer provides STI to a small homogeneous audience with little thought to potential applications of the knowledge, especially applications outside the specialized community of scientists and technologists. The costs of access for public managers are such that a common "solution" is simply to ignore relevant STI. But agencies that are science-intensive (agencies dealing with such issue areas as water quality, agriculture, energy production and regulation, public health, conservation) can ignore STI only at their peril. Indeed, if we

include information produced by social scientists, it is difficult to imagine a broad policy issue for which there is no relevant body of STI. While STI is frequently voluminous, fragmented, conflicting and obscure, it is often more reliable than other types of expository information and is frequently more relevant to problem-solving than "simple" information. Thus, another interpretation of the public manager's lament is that "I need more information that is reliable and externally valid."

Information Preferences and Behaviors

With a few exceptions (Caplan 1976; Bozeman and Blankenship, 1979; Feller et al., 1975), studies of the use of STI have concentrated on scientists, technologists and R&D organizations rather than public managers (See Compton, 1973). While it is clear that public managers differ from scientists in use and acquisition of STI, there are parallels between engineers ("physical technologists") and public managers ("policy technologists") in regard to information needs, search patterns and applications (Bozeman, Roering and Slusher, 1978; Bozeman and Fitzgerald, 1978). Thus, findings of studies focusing on private R&D organizations are of some relevance for our effort to determine patterns of STI use among public managers.

This study of public managers' STI preferences and behaviors is based on data gathered from questionnaires mailed to officials of the Canadian government's Environmental Protection Service¹, many of whom have had scientific training and are working on science-intensive policy problems. By studying an "advantaged" group of public managers we can obtain some insight into the STI behaviors that can be expected in circumstances that

approach the ideal (i.e. public managers with clear needs for STI and exceptional ability to access STI). It would, of course, be beneficial to follow this study with an analysis of more "typical" public managers and "disadvantaged" public managers. A different, and useful, perspective is to be gained in each case.

Channel Preference

The objective of the examination of channel preferences is to determine public managers' perceptions of the value of certain types of STI channels. The channels investigated include scientific and professional journals, computerized information systems, co-workers, personnel in other government agencies, university faculty and staff, persons in interest groups, libraries and one's immediate supervisor. By standard usage, journals, computerized information systems and libraries -- none of which can be accessed directly without comparatively "high effort" scanning -- are considered formal channels; the others, accessed via interpersonal communication, are classed as informal channels.²

The policy significance of channel preference is straightforward: if clear patterns of preferences can be identified, it may be possible to suggest how the public organization's resources should be distributed so as to most effectively filter STI into the policy-making/administrative processes. If public managers express a preference for, say, journals, then an argument can be mounted that the agency might do well to support subscriptions to journals that provide information relevant to the mission and programmatic goals of the agency. But if public managers express little enthusiasm for formal STI, other STI resource-building strategies might be pursued. For example, funds might be allotted in such a way as to

maximize information obtained from interaction with scientists or engineers, including consultants.

For a variety of reasons it is helpful to explain variance in channel preference. For example, an agency that relies heavily on a capital - intensive computerized information system might wish to know correlates of preferences for such a system and might wish to go so far as to recruit persons that are comfortable with such a mode of information-seeking or to provide appropriate training for individuals in order to make the heavily capitalized system productive.

"Gatekeeping"

The gatekeeping concept has long been familiar in communications theory and has been employed in a variety of ways. The research of Thomas Allen and his colleagues (Allen, 1977; Allen and Cohen, 1969; Gerstberger and Allen, 1968) is particularly relevant. Allen employed the term gatekeeper to refer to individuals in R&D labs who acquire much higher levels of STI than is the norm and frequently pass on the information, often in reprocessed, reduced or less technical form, to colleagues. Allen and Cohen (1969) have conducted research about the attributes of such gatekeepers and note that (1) they are (in the authors' terms) the "stars of the R&D lab," (2) they are typically oriented toward both formal and informal channels, (3) they have higher visibility and higher status in the broader scientific/technological community, and 4) they tend to be first line supervisors.

If there are public managers enacting information sharing roles similar to the gatekeeper role of the R&D lab, they are a vital resource that should be recognized and nourished. If public managers identify strongly

with the organization, they are likely to look to co-workers for STI. There is some evidence that accessibility is the chief determinant of information channel selection (Allen, Gerstenfeld and Gerstberger, 1968), and this would argue the importance of co-workers in one's agency as a source of STI.

The variables we employ to measure gatekeeping are not sufficiently precise to allow us to clearly identify gatekeeping roles in the Allen usage of that concept. Our "gatekeeper" is simply an individual that is frequently called on for STI, reports a greater interest in STI and provides unsolicited STI.³

Determinants of Information Behavior

There are four clusters of variables that are expected to have relevance for both channel preference and gatekeeping. The Job Perceptions cluster is composed of only two variables, one pertaining to job satisfaction, the other to perceptions of co-workers.⁴ Our most basic expectation was that persons reporting dissatisfaction would be more likely to look to formal channels for STI and would prefer interpersonal information sources other than co-workers or supervisors.

Muchinsky (1977) has found that high degrees of communication and information sharing are associated with increased job satisfaction. We may extend these findings (which did not deal with STI) and hypothesize that those placing low value on co-workers and supervisors as STI sources and those who are least active in "gatekeeping" will report lesser job satisfaction. It is worth noting in relation to these expectations that a recent study (Marrett, Hage and Aiken, 1975) found communication and job satisfaction related, but satisfaction was no greater when communication was informal.

The Administrative Role cluster includes indicators of the amount of time devoted to administration and the amount of administrative responsibility involved in one's job. Additionally, this cluster includes an age variable because of the high degree of statistical confluence between age and administrative duties.⁵ As was indicated in the discussion of gatekeeping, Allen's studies have consistently shown that first line administrators are most likely to exhibit gatekeeping behaviors. A recent article by Bacharach and Aiken (1977) provides strong support for the idea that administrative role variables are of critical importance to communication patterns and boundary spanning activities.

The Professionalism cluster is composed of variables pertaining to number of professional membership held, number of professional meetings attended, publications, and highest degree.⁶ The Professionalism variables indicate ties to scientific and technological communities and, perhaps, can serve as rough indicators of memberships in "invisible colleges" (Crane, 1972).

Analysis and Findings

We employ zero order correlations and multiple regression to test the relationships between the clusters of independent variables and the STI behavior/preference variables. It was necessary to derive single dependent variable measures that could be employed in a regression equation. In the Gatekeeping cluster, a single variable was created by transforming the data from raw numbers to quartile ranks and then summing to derive a single measure. In order to reduce the number of variables in the Channel Preference cluster, a factor analysis was performed which yielded three factor dimensions with factor loadings that indicated that they might be conveniently thought of as representing, respectively, Formal Channel Preference, Informal Channel/Inside Agency Preference and Informal Channel/Outside Agency Preference.⁷

Table 1 provides the findings for the regression of the factor scores for each of the three channel preference factor dimensions on the independent variables for each of the respective predictor models.

- - TABLE ONE GOES HERE - -

Each of the three clusters of independent variables is significantly (at the .05 level) associated with one channel preference variable. Job Perceptions and Administrative Role account for some variance in preferences for formal channels, and Professionalism is the lone model that is of any significance in explaining preferences for Factor III, Informal Channel/Outside Agency Preference (and then only the variable pertaining to professional organization memberships is of any value). Factor I, Formal Channel Preference, is best explained by the four predictor models taken together. This may be partly explained by the facts that it is the factor dimension that accounts the most variance in the correlation matrix of the channel preference variables (i.e., it has the highest eigenvalue), and it has the most coherent dimensional structure.

We can summarize the findings as follows: (1) preference for formal channels is related to increased age (independent of administrative responsibilities), and low opinion of co-workers; (2) preference for informal channels within the organization (including co-workers and supervisor) is well accounted for by none of the independent variables; (3) preference for informal channels outside the agency is significantly related to number of memberships in professional organizations (perhaps meaning that the channels outside the organization are richer in information).

The findings are for the most part straightforward. A conspicuous exception is the finding that age is significantly and positively associated with preference for formal channels. This finding goes against evidence

for users of STI in other organizational contexts (Line 1970). Our first impulse would be to argue that age is a surrogate for administrative responsibility, but as Table I shows, none of the Administrative Role variables is significantly related, only the age variable (which was introduced, incidentally, as a control).

Table 2 gives the findings for "Gatekeeping".

- - TABLE TWO GOES HERE - -

As was expected, the model explaining the greatest variance in "Gatekeeping" is Professionalism, though each model includes individual variables significantly associated with Gatekeeping. The findings indicate that public managers most oriented toward information sharing are those with less favorable perceptions of their job and co-workers and, the more "professional". The findings in regard to Administrative Role are ambiguous; gatekeeping behavior can be expected from specialists rather than generalists, but the other variables (none significant) are in the other direction.

Discussion

This study of officials of the Canadian Environmental Protection Service showed that variations in preferences for STI channels and patterns of information sharing ("gatekeeping") could be accounted for in terms of a number of perceptual and task-related variables.

The findings can be summarized as follows:

- (1) Preference for formal channels is associated with a low opinion of co-workers; increased age (independent of administrative responsibility).
- (2) Preference for informal channels outside the organization is associated with memberships in professional organizations.
- (3) "Gatekeeping" is associated with a low opinion of co-workers;

doctoral-level degree; high attendance at professional meetings; specialization.

Conceptual studies (Bozeman, Roering and Slusher, 1978; Bozeman and Fitzgerald, 1978) have suggested that organization structures may be changed and public agencies' resources may be reallocated in ways that will enhance the information processing and management abilities of public agencies. The findings presented here are too limited to be of direct instrumental use, but may be used as a backdrop for consideration of strategies for developing scientific and technical information systems (STIS).

Since individuals apparently vary a good deal in their preferences for particular channels, they should have the opportunity to employ those with which they feel the most comfortable and with which they can deal effectively. But given the bias toward informal channels reported here and elsewhere (Bozeman and Blankenship, 1979), additional resources are especially needed in support of informal channels.

It is more difficult, in many cases, to build an information base relying on informal channels. Building up formal channels often requires considerable resources but little imagination: appropriate trade and profession journals are acquired and effectively routed, mechanized information systems are designed and implemented, agency-based and government-wide libraries are developed.

The tasks required to develop informal channels and attendant resources are less evident.

One approach is essentially structural. With the exception of government laboratories and some agencies chiefly involved in distribution R&D funds, science-intensive public agencies have not often departed from the classical

functional organization structure. Public managers have been reluctant to experiment with such modern structural alternatives as free form, matrix and project management even though there appear to be advantages in promoting the diffusion of information obtained from external sources (Cleland and King, 1968). Matrix organization, which involves the overlaying of project structure on functional structure to produce a matrix, has been shown to enhance horizontal communication while at the same time maintaining a substantial degree of control and managerial accountability. Matrix design might well be appropriate as a structure for a STIS.

However, "informal organization" is often as important to the functioning of the agency as the formal structure. Being unplanned, the informal organization springs up to meet needs not met by the formal organization and is at the vanguard in adapting to change. In designing an effective STIS one basic rule is that the system not be so rigid as to thwart the workings of the informal organization, a source of considerable work-related information including, in many cases, STI. As a minimum, gatekeepers -- usually an informal role -- must be allowed to function effectively. As Taylor and Utterback (1975) observe, "it is apparently difficult to create a technical gatekeeper, but possible to reduce their effectiveness in technical communication". An overly structured STIS may, if it encroaches on the informal organization, endanger the gatekeeping role.

While it is not clear that gatekeepers can be systematically developed, they can be systematically supported. A variety of steps may be taken, including providing gatekeepers with greater and more timely access to STI resources and strategically locating the gatekeeper in the organizational unit. If a STIS is to be self-consciously designed, the gatekeepers should be instrumental in its development and structuring.

Footnotes

1. In late July, 1978, questionnaires were mailed to 134 officials (a population) who were listed in Government of Canada Telephone Directory as employees of the Environmental Protection Service. Persons who received questionnaires were those involved in research, analysis, program management and/or supervision of program related functions (financial management personnel, for example, were not included). There was a 48% response rate (a follow-up letter was mailed three weeks after the questionnaires). It was not possible to measure respondent bias.

2. Respondents were asked "About how would you state each of the following as a source of scientific and technical information related to your work?" Items: "Co-workers in my agency office;" "Personnel in other government agencies;" "Computerized information services;" "My immediate supervisor;" "Scientific and technical journals" (Code: "Of no value;" "Very little value;" "Some value;" "Great value.")

3. Items included: "I often provide my co-workers with STI or citations even if not solicited;" "I regularly respond to my co-workers' questions about some research-based information;" "I have a greater interest in STI than my co-workers." Response code: "Strongly disagree;" "Disagree;" "Not sure;" "Agree;" "Strongly agree" (This code will be subsequently referred to as "Standard" Code).

4. The two items for the "Job Perceptions" cluster and their variable names are: "Every job has its drawbacks, but overall I am satisfied with my job" (Job Satisfaction); "My co-workers are, for the most part, a group of bright and interesting people" (Co-workers). Response code: Standard.

5. The "Administrative Role" cluster includes: "My job is more that of a generalist than a specialist" (Generalist), response code: Standard; "What percentage of your time is devoted to administrative tasks?" (Percent Administrative); "How many people (if any) do you supervise? (Number supervised).

6. The "Professionalism" cluster includes: "How many (if any) professional or scientific memberships do you hold?" (Professional Memberships); "How many (if any) articles have you published in scientific or professional journals?" (Publication); "About how many scientific or professional meetings do you attend each year?" (Professional Meetings); "What is your highest earned degree?" Note: later re-coded to Ph.D./non-Ph.D. (Degree).

7. A principal-components analysis was performed on a cluster of variables dealing with source use. Respondents were asked to rate, on a four-point scale, the following as a source of scientific and technical information related to your work?" a) co-workers in my agency, b) personnel in other governmental agencies, c) university faculty and staff, d) persons in private interest groups, 3) public, agency, or university libraries, f) computerized information services, g) my immediate supervisor, and h) scientific and technical journals. Also included in the source use cluster were two Likert scale items: a) "The telephone is the best information source I know", and b) "I had just as soon read a scientific article as have a colleague tell me about it."

The decision on the number of factors to rotate follows the Screen test (Rummel 1969), which involves plotting the eigenvalues of the principal axes. A varimax rotation was used to obtain a simple structure

solution. The following are rotated factor loadings which were above .50:

<u>Factor I</u>	<u>Factor II</u>	<u>Factor III</u>
Formal Channels Preference	Informal Channels: Inside Agency Preference	Informal Channels: Outside Agency Preference
Libraries .74	Co-workers .74	University Faculty and Staff .74
Computerized Information Services .81	Other Agencies' Staff .71	Interest Groups .72
Journals .58	Journals .58	
Telephone -.54		
25%	18%	12%

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Table 1: State One Regression Findings for Channel Preference

CHANNEL PREFERENCE

Factor 1: Formal Channel Preference

	<u>beta</u>	<u>r</u>	<u>R²</u>
<u>JOB PERCEPTIONS</u>			
Co-Workers+	-.343	-.36**	.131
Job Satisfaction	.131	-.11	.136
<u>PROFESSIONALISM</u>			
Publications	.261	.29**	.085
Professional Memberships	.049	.15	.087
Professional Meetings	.031	.13	.088
<u>ADMINISTRATIVE ROLE</u>			
Age	.394	.35**	.121
c/o Administrative	.167	.07	.152
Generalist	-.038	-.08	.154
Number Supervised	-.037	-.03	.155

Factor II: Informal Channel/Inside Agency Preference

<u>JOB PERCEPTIONS</u>			
Co-workers	.314	.23*	.055
Job Satisfaction	-.164	-.02	.076
<u>PROFESSIONALISM</u>			
Professional Meetings	.051	.04	.001
Professional Memberships	-.047	-.02	.003
Publications	.018	.02	.003
<u>ADMINISTRATIVE ROLE</u>			
Generalist	.287	.26*	.069
Number Supervised	-.117	-.04	.079
Age	.084	.06	.088
c/o Administrative	-.028	-.07	.088

Factor III: Informal Channel/Outside Agency Preference

<u>JOB PERCEPTIONS</u>			
Co-Workers	-.193	-.14	.021
Job Satisfaction	.057	-.05	.024
<u>PROFESSIONALISM</u>			
Professional Membership	.400	.34**	.117
Publications	-.137	.01	.134
Professional Meetings	-.017	.05	.134
<u>ADMINISTRATIVE ROLE</u>			
c/o Administration	-.134	-.160	.025
Number Supervised	.075	.116	.032
Generalist	.065	.102	.036

+ First variable listed in column was first variable entered in stepwise regression.

* A correlation of $> \pm .20$ is significant at .05 level.

** $> \pm .28$ significant at .01.

Table 2: Stage One Regression Findings for "Gatekeeping"

"GATEKEEPING"

	<u>beta</u>	<u>r</u>	<u>R²</u>
<u>JOB PERCEPTIONS</u>			
Co-workers	-.314	-.30**	.090
Job Satisfaction	-.070	-.17	.091
<u>PROFESSIONALISM</u>			
Degree: Ph. D./non-Ph.D.	.392	.29**	.088
Professional Meetings	.281	.24*	.132
Publications	-.205	.08	.160
Professional Memberships	-.043	.12	.161
<u>ADMINISTRATIVE ROLE</u>			
Generalist	-.234	-.23*	.054
Number Supervised	.158	.10	.076
Age	.142	.13	.088
c/o Administration	.141	.11	.106