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Patterns of Scholarly Communication in Information Policy: A Bibliometric Study

IAN ROWLANDS
Department of Information Science, City University, London, UK

This paper reports on a bibliometric investigation into the structure and dynamics of the information policy journal literature. The unit of analysis is a document test collection of 771 articles published between 1972 and 1996. This test collection was compiled from records in the multidisciplinary database *Social Sciences Citation Index*®. The investigation focuses on patterns of growth, knowledge accumulation, ageing and obsolescence, documentary scatter and knowledge production. It concludes that the structure and dynamics of the information policy journal literature diverges in several respects from typical social science literatures. Information policy is characterised by very rapid growth, high immediacy (in Price's sense), rapid reception and ageing processes and relatively low documentary scatter. These findings are put in the context of related work in bibliometrics and in the sociology of science wherever possible.

Introduction

This paper presents the findings of a simple bibliometric study into the structure and dynamics of the information policy journal literature, 1972–1996. A document test collection comprising 771 (mainly refereed) articles, identified using the multidisciplinary database *Social Sciences Citation Index*®, was created for the purposes of this investigation. This test collection includes original papers and review articles addressing information policy issues of general public interest. Articles on organisational information policy were excluded. Only articles longer than three pages were included, and the test collection further excludes bibliographies, book reviews, letters, editorials and abstracts. Search terms were derived from the author's own faceted classification of the field of information policy (see Table 1, cf. p. 62).

This paper attempts to locate its findings in a broad social science context. After all, bibliometrics is not an end in itself; it is simply a tool for helping us to construct a better understanding of the intellectual and social structure of a given field of study.

Summary characteristics of the test collection

This paper presents an overview of the key bibliometric features of the document test collection. Wherever possible the findings are related to published studies, drawn mostly from the library and information science literature. This is intended to locate the results within a more meaningful context, although the reader is cautioned from drawing *direct* comparisons between this and other bibliometric studies. In a critical review of bibliometric and other science indicators, King (1987) notes that there are no commonly agreed standards or guidelines for conducting bibliometric studies and therefore few, if any, reliable field-independent indicators.

The bibliography is dominated by the English language, which accounts for 97 per cent of all articles. The other languages represented are German, French and Russian [1]. This raises a funda-

Dr Ian Rowlands is a director of the Information Policy Unit and leads the MSc Information Science programme at City University. For further information, contact: Department of Information Science, City University, Northampton Square, London EC1V 0HB, UK. E-mail: ir@is.city.ac.uk

Table 1. The Field of Information Policy

Information infrastructure policies
Research & development; libraries, archives and public records; telecommunications.
Information management in government
Collection and acquisition of information by government; IRM in government: policies and practices; government information systems.
Information access and control
Freedom of information; confidentiality and personal privacy; national security issues.
Information industry policies
Information standards and protocols; copyright, IPR and information law; information industry regulation; transborder data flows.
General articles on information policy
Theoretical aspects of information policy; national and international information policies.

(Adapted from Rowlands 1998).

Table 2. Summary Bibliometric Indicators

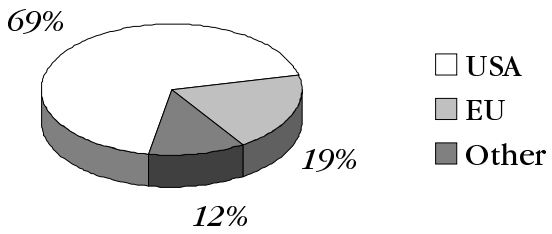
Primary indicators:	
Number of articles, A	771
Number of serial titles, J	181
Number of authors, a	632
Number of corporate authors, c	231
Number of citations to A	1,191
Derived indicators:	
Articles per serial title (A / J)	4.26
Articles per author (A / a)	1.22
Articles per corporate author (A / c)	2.77
Authors per article (a / A)	1.03

Table 3: Distribution of Articles by *ISI* Journal Category

Journal category:	Articles:
Business & Management	15
Social Sciences	24
Communication Studies	26
Political Science	31
Public Administration	32
Law	92
Library & Information Science	540

mental concern – the extent to which the distributions observed in the test collection can be generalised to the information policy journal literature as a whole. There is much discussion in the bibliometrics literature concerning the incompleteness of *ISI* (Institute for Scientific Information) database files [2] and the issues that this raises (see, for example, Osareh 1996: 221). The

Figure 1. Distribution of Articles by Geographical Location of First Author



limitations imposed by *ISI* editorial policy (and the possibility that this policy may have changed over time) are difficult to avoid. Kärki cautions that when *ISI* citation indexes are used as a source, the resulting coverage may be "biased in favour of Anglo-American research" (Kärki 1996: 329).

The geographical provenance of articles in the test collection (as determined by the corporate address of the first author) shows that US contributions figure strongly. This is unsurprising, however. The US has a sophisticated and highly developed set of public information policies and possibly the most highly institutionalised environment for information policy research.

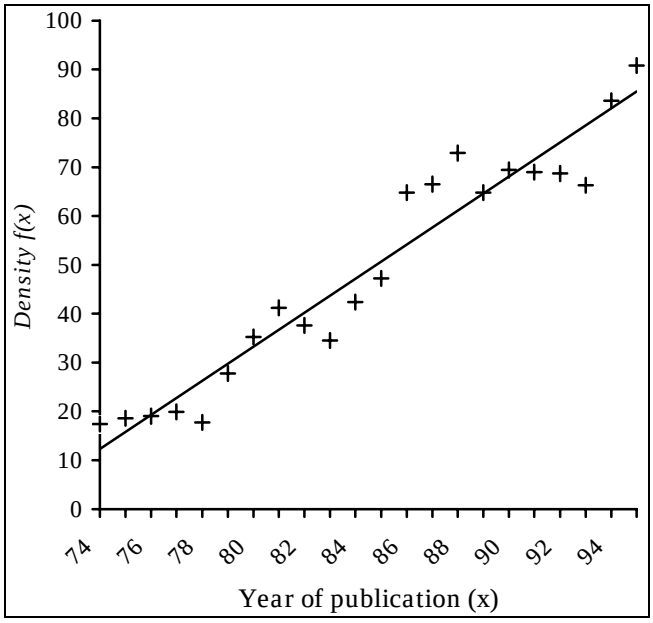
The European Union category is largely accounted for by articles from British (10.9 per cent), German (3.0 per cent) and European Commission (1.8 per cent) authors. The remaining category includes articles from Australasia, Southeast Asia, Japan, the Middle East, India, Latin America, and those countries of Europe currently outside of the Union.

The disciplinary profile of the test collection is represented in Table 3 as a distribution of articles by *ISI* journal category. The *ISI* journal category is assigned *at the level of the journal title* and so it does not provide any indication of the subject nature of individual articles. The Table should therefore be interpreted as responding to the question 'where do information policy authors publish?' and no construction about topics or authors' institutional affiliations should be inferred.

The main destination for information policy articles is library and information science journals, with further representation across a broad canvas of legal, political and social science titles. This empirical evidence offers some limited support for the often rehearsed view that information policy is multidisciplinary in scope and character (see, for example, Burger 1993).

The distribution of article production over time shows that there has been a sustained and growing interest in information policy topics over the period 1972 to 1995. Cumulative article production is represented in Figure 2 as a proportion of all *Social Sciences Citation Index*® records. The data are expressed as bibliography entries per 100,000 *Social Sciences Citation Index*® records, and presented as a three-year moving average. The trendline [3] suggests that the volume of information policy articles is expanding in both absolute and relative terms. In other words, information policy is capturing greater 'market share' within the total population of records indexed by *Social Sciences Citation Index*®. The information policy journal literature appears to be doubling in volume approximately every six years.

Figure 2. Relative Article Production



Knowledge accumulation

These observations on the growth of the information policy journal literature are interesting, but they tell us nothing about the *processes* underlying that growth. This section considers the scholarliness and age distribution of the supporting (cited) literature.

The test collection is broadly based, encompassing research-based and opinion articles and articles by academics and practitioners. Windsor and Windsor (1973) argue that the ratio of source papers without references to those with references offers a measure of the maturity and 'scholarliness' of a given literature. In the case of the information science literature, Windsor and Windsor found this ratio to be 30:70 [4]. The information policy test collection performs 'very well' by this standard, with a ratio of 13:87 across the test collection, although this possibly says as much about *ISI* editorial standards as it offers fundamental insights into the structure of the information policy literature.

The Windsor ratio reports on just one aspect of how authors interact with existing knowledge: through their referencing behaviour. It tells us nothing about the nature of their use of the accumulating body of recorded literature. Information scientists have long been interested in the differences in the way that knowledge accumulates in various subject areas. One important aspect of knowledge accumulation is the extent to which older materials are knitted into the fabric of more recent publications through citation. As long ago as 1953, Stevens claimed that science and technology:

> … exhibit a high concentration of papers in a select nucleus of special journals, and also in a brief span of time covering a few current years. In contrast, the literatures of the social sciences and humanities exhibit a great dispersion of publications in different forms, on different subjects, and over a comparatively long span of time (Stevens 1953, 12).

Price also noted that science distinguishes itself from other fields of study in the way that scientists refer to their literature. If references to the existing literature were distributed evenly across the entire archive of material which was available to be cited, he reasoned that the age distribution of references in any one year should reflect the age and size of the archive. Instead, he found that more recent papers in science were much more likely to be cited than his simple probability model suggested and in a 1970 article, he introduced a new bibliometric indicator, Price's index (PI).

This is given by:

$$PI = (n_1 / n_2)*100$$

where, for a given paper, n_1 is the number of cited references with a relative age of less than six years [5] and n_2 is the total number of references.

Table 4. Comparative Price Indices

Social Studies of Science (a)	37
Science Studies (a)	41
Scientometrics (b)	43
JASIS (b)	46
Information policy articles	60

(a) Spiegel-Rösing 1977.
(b) Wouters & Leydesdorff 1994.

Price found that the value of the index varied according to the discipline or field of study under investigation:

> Perhaps the most important finding I have to offer is that the hierarchy of Price's index seems to correspond with what we intuit as hard science, soft science, and non-science as we descend the scale. Biochemistry and physics are at the top, with indexes of 60 to 70 percent, the social sciences cluster around 42 percent, and the humanities fall in the range 10 to 30 percent (Price 1970, 4)

Price dubbed this phenomenon the 'immediacy effect' and further proposed the existence of two main types of literature: the 'ephemeral' and the 'classical'. The value of Price's index may be determined in two ways. Price himself used a global measure while Moed (1989) proposed an improvement by calculating the average index value across a population of articles and excluding the sub-populations with index values of 0 or 100 per cent. The values for Price's index for the information policy test collection are thus:

- Price's global measure 60 per cent
- Moed's 'corrected' average 57 per cent

Whichever way the index is calculated, the value is surprisingly high, as the comparative data in Table 4 demonstrate.

The data presented above compare Price's index for the information policy test collection with available published figures for four social science journals. The value for Price's index is much higher than one might have anticipated; indeed it suggests that the citation practices of information policy authors more closely resemble those of workers in the natural rather than the social sciences. A possible explanation for this apparent anomaly is that information policy is a relatively small field (smaller than scientometrics?) with a consequently small archive to draw upon. However, Price's index shows a high degree of stability over time and appears to be a structural feature of the literature.

What conclusions can be drawn from these results? Information policy is evidently not a hard science, although its authors do seem to share with, say, biochemists, a tendency to emphasise more recent works in their reference lists. In developing an explanation of his empirical data, Price reached for the major concept available at the time (1970) to describe differences between disciplines – the hierarchy of the sciences introduced nearly two centuries earlier by Comte. This hierarchy emphasises cognitive structure and it perhaps sits uneasily with the essentially sociological patterns of behaviour that Price was observing. Particularly incongruent here is Price's assertion that that it is the concerted attention of scientists that produces the immediacy effect:

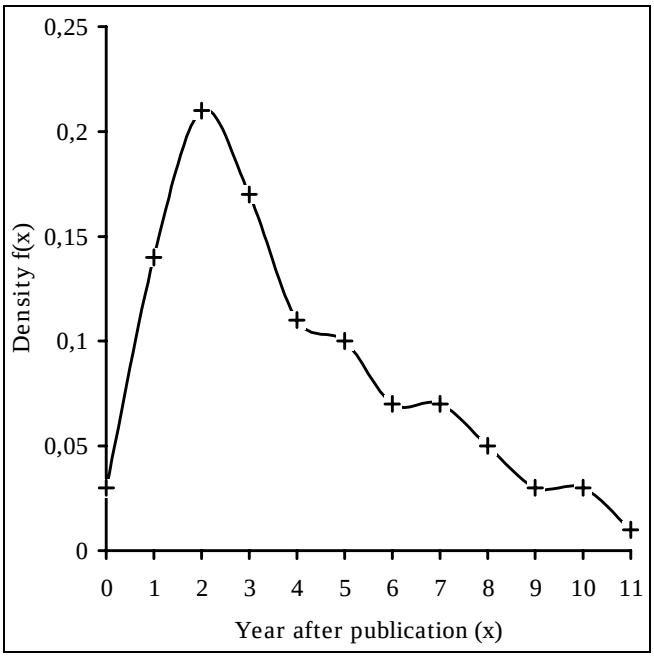
> ... if you want to make the field firm and tight and hard and crystalline you have to play with your peers and keep on the ball by citing their recent work (Price 1970, 15).

In other words, a relatively high degree of consensus, more usually the case than not in the hard sciences, might be expected to be a good predictor of 'high' index values. The tacit assumption of Price's work and those that have followed is that such high levels of consensus do not obtain in the social sciences or arts and humanities. In a major review article, however, Cole (1983) rejects this notion and argues that in some cases, social sciences do exhibit high levels of consensus. Cole further suggests that the fundamental differences between disciplines lie not in citation habits but in the structure of their knowledge systems, particularly in relation to how empirical knowledge is codified into "succinct and interdependent theoretical statements" (Cole 1983, 112).

Intriguingly, Cozzens (1985) points out that several co-citation studies of the development of disciplines have found a relationship between immediacy and periods of intellectual focus [6]:

> At times of intellectual excitement, whether in response to a recent breakthrough which has opened up a new set of interesting questions or because researchers are trying to resolve a theoretical issue, members of the speciality concentrate their references more heavily on a few papers, and the literature they cite tends to be more recent than it is at other times (Cozzens 1985, 436).

Figure 3: Age Distribution of Citations



The results of these studies suggest that a causal explanation for Price's immediacy effect is likely to be sociological in its origin. The high index values associated with the information policy literature may be indicative of a higher degree of consensus and intellectual focus than anticipated, rather than pointing to a cognitive structure which is similar to the higher levels of the Comte's hierarchy of the sciences.

Ageing and obsolescence

The material in the previous section related to the use made of the supporting literature by authors represented in the test collection. In this section, the attention shifts to how information policy articles are themselves cited. The main objective is to examine the ageing of the information policy journal literature by seeing how citations are distributed in time. While citations alone cannot depict the totality of the reception, ageing and obsolescence processes (data on document use would be needed to explore this fully), the distribution at least indicates how information policy articles are received by one group at one point in time when those other authors are preparing their own work for publication. The data in Figure 3 were compiled by searching for the citations to date (299) to the 127 bibliography entries published over the period 1981–85.

Table 5. Comparative Citation Half-Lives

Field	Citation half-life (yrs)
Information *policy*	***3.0***
Metallurgy	3.9
Chemical engineering	4.8
Genetics	5.0
Information systems	5.0
Physics	5.2
Mechanical engineering	5.2
Desalination	5.6
Chemistry	8.1
Archaeology	9.5
Botany	10.0
Mathematics	10.5
Geology	11.8
Music education	12.5
Music theory	12.5
Biblical criticism	21.6

(Adapted from Cunningham & Bocock 1995)

One characteristic of a rapidly ageing, as opposed to a more classical, literature is a skewed distribution and a relatively small median value. The pattern displayed in Figure 3 suggests that information policy articles enjoy a period of rapid citation over the first three years (reception), followed by a relatively slow decline (obsolescence) over the following eight or nine years [7]. The citation half-life for the test collection articles is three years; unsurprising in the light of the high Price's index for the literature, but certainly more typical of the patterns usually observed in the natural sciences. Bottle and Gong, for example, returned an identical estimate (three years) for the citation half-life of biochemistry literature (Bottle & Gong 1987).

Bradford studies

Attempts to identify 'core zones' in bibliographies of journal articles can be traced to the work of Bradford (1934). In this section, the main corpus is partitioned into zones in order to identify the most highly productive serial titles. The Bradford concepts of 'core' and 'scatter' are important for this paper because they are to some extent indicative of the underlying social and intellectual structure of the field of study. Chubin observes that:

> If there was no 'scatter', scientists would be divided into small groups sharing the same interests, speaking only to each other, and reading and citing only each other's work

> ... Both [core and scatter] are necessary, the former to permit scientific knowledge to cumulate and grow, the latter to prevent it from becoming a ... sect-like phenomenon (Chubin 1976, 472).

In less highly structured or specialised disciplines there is a general expectation that people will read widely outside of their own current areas of concern. In arts and humanities subjects, for example, potentially relevant ideas may be gleaned from a very wide variety of sources. The breadth of influences to which a researcher is receptive is of course a function both of personal inclination and of disciplinary conventions.

Nadel suggests that catholicity of interests is also a function of the maturity of a specialty. He noted that in its early stages, research on superconductivity was characterised by a dispersion of articles in a variety of journals but that it later became 'institutionalised' by the increasing concentration of published material in a relatively limited number of specialist sources (Nadel, 1980). A tentative causal explanation for this effect is that it becomes more and more difficult for the typical researcher to stay abreast of developments across an increasingly specialised field because of the inaccessibility of language and logical structures in the adjoining literatures.

Bradford (1934) was the first to draw attention to statistical regularities in the distribution of articles across journal titles in (reasonably comprehensive) subject bibliographies. Most of the published empirical investigations into Bradford's Law have come from the natural and medical sciences and only rarely from the social sciences (see, however, Coleman 1993).

Following Bradford's example, the journal titles represented in the test collection were ranked according to the number of articles each contributed to the bibliography. This ranked list was then partitioned into five zones of decreasing productivity (Table 6).

Table 6. Bradford Partitioning

Bradford zone	J	A	Multiplier
I	1	150	
II	2	150	2.00
III	9	147	4.50
IV	42	167	4.67
V	127	157	3.02
All zones	181	771	3.55

Table 7. Test Collection Journals by Bradford Zone and *ISI* Journal Category

ISI journal category	I	II	III	IV	V
Information & library science	1	1	6	24	19
Communications studies		1		3	5
Law			2	7	41
Public administration			1	3	4
Politics / international relations				1	17
Other				4	41
All categories	1	2	9	42	127

The minimal nucleus for the test collection consists of a single journal, *Government Information Quarterly*. The two journals in Bradford zone II are (in decreasing order of productivity):

- *Journal of Government Information* (incorporating Government Publications Review)
- Telecommunications Policy

The journals in Bradford zone III are (in decreasing order of productivity):

- *Aslib Proceedings*
- *Proceedings of ASIS*
- *Journal of Information Science*
- *Public Administration Review*
- *Int'l Forum on Information & Documentation*
- *Duke Law Journal*
- *Information Age*
- *Administrative Law Review*
- *Journal of ASIS*

The twelve most productive journals in the bibliography thus comprise only 6 per cent of all titles but yield 58.0 per cent of all articles. Eight of the twelve most productive journals occupy a central position in the library and information science literature. The other four (*Telecommunications Policy, Public Administration Review, Duke Law Journal* and *Administrative Law Review*) could hardly be categorised in this way although the potential relevance of these titles to the field of information policy is evident.

Table 7 shows a breakdown of the test collection journals by Bradford zone and *ISI* journal category. This analysis suggests that the core information policy journals are mainly library and information science titles and that other journal

categories contribute disproportionately to the outer Bradford zones. This is an interesting finding in relation to the debate about whether information science is indeed the most natural home discipline for information policy studies (see Burger 1993, passim).

Much attention in the bibliometric literature has focused on the generalisability of Bradford's Law and, in particular, on the goodness of fit with linearity obtained in experimental bibliographs. Departures from linearity have attracted some attention and attempts at explanation (see, for example, Drott 1981). In a 1993 paper, Coleman suggested that there is a relationship between linearity and the homogeneity and completeness of a bibliography.

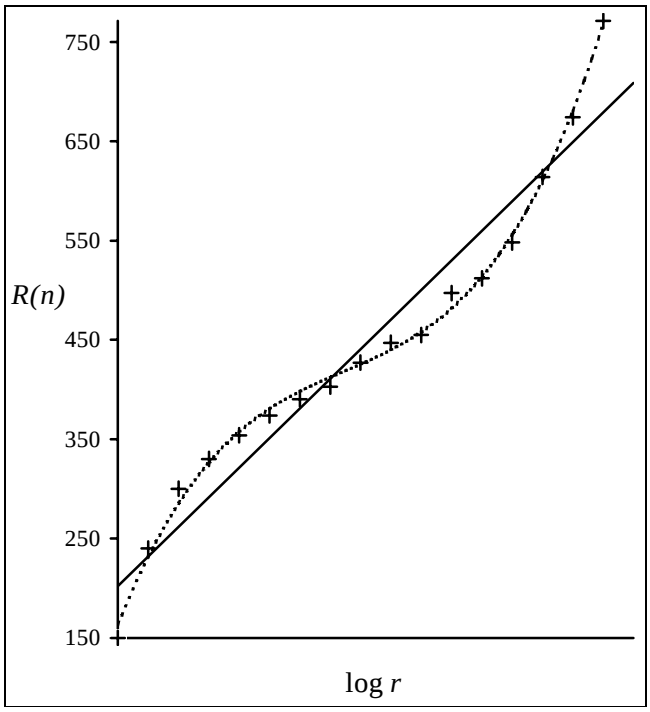
Figure 4 is a 'bibliograph' which plots the logarithm of a given journal's rank, *r,* against the cumulative number of articles up to that point, *R(n).* The solid trendline is a linear regression model [8] while the dotted trendline represents a curvilinear expression [9]. It will be noted that the curve obtained here is definitely *S*-shaped as opposed to the more usual 'classical' *J*-shaped distribution of many published bibliographs.

One might expect *a priori* that 'information policy' might best regarded as a heterogeneous rather than a homogenous construct. Berelson (1960) draws a useful distinction between *data specialties* and *word specialties*. Data specialties (experimental psychology, for instance) are those which are characterised by distinctive, public procedures, standard methodologies and special apparatus. Word specialties (such as information policy) are, in contrast, less tightly defined in terms of topic, procedure, institutional structures, purpose or even in terms of a consensus around the fundamental paradigms employed.

Coleman argues that the bibliometric characteristics of word specialties differ from data specialties, since the latter enjoy:

> ... a level of standardisation that reduces ambiguity in the task of making distinctions between publications that are proper to that speciality and those that belong to neighbouring specialties ... A word-based speciality does not enjoy the same capability because, although it may have a somewhat distinctive vocabulary, concepts are more easily borrowed by and from neighbouring word-based specialties than are apparatus and procedures. Such movement of concepts contributes to a blurring of boundaries between word-based specialties and makes it necessary for both the bibliographer and the journal editor to distinguish properly among the publications of cognate specialties. As a result ... the journal editor finds the topical hierarchy of the journal fuzzy and hard to obey. Thus, the bibliography of a word specialty ought to show less concentration than that of a data specialty (Coleman1993, 88).

Figure 4: Bibliograph of Journal Productivity



Information policy certainly appears to sit well with Berelson's conception of a word specialty; the term is an umbrella designation embracing a variety of topics and approaches (the elucidation of which is a central aim of this paper). Coleman's remarks above also point to the difficulties of obtaining a complete bibliography for a word-based specialty.

Patterns of knowledge production

This section considers a number of aspects of author productivity in information policy. The records in *Social Sciences Citation Index*® are indexed by first-named author only and the discussion which follows is based entirely on patterns observable in the distribution of these authors. While this means that the results are distorted, the decision to proceed on this basis was based on practical considerations. For instance, it facilitates comparison with the many existing bibliometric studies that share the same limitation. It

Table 8. Comparison of Lotka Studies

Literature	Mean n	Source
Natural sciences	2.20	Nicholls (1988)
Information policy	2.34	Rowlands
Social sciences	2.49	Nicholls (1988)
Humanities	2.55	Nicholls (1988)

(Adapted from Nicholls 1988)

Table 9. Distribution of Multiple Authorship

Number of co-authors	Number of articles
0	630
1	106
2	25
3 or more	10
Total articles	771

should also be noted that the incidence of collaborative authorship in the test collection is very low compared to other literatures; a visual inspection of a listing of second and subsequent named authors suggested that the vast majority of these individuals would only be represented by a single article.

In 1926, Lotka proposed a distribution that modelled the frequency distribution of scientific productivity ('Lotka's Law'). Lotka's law takes the form $y_x = c/x^n$, where y_x is the number of authors credited with x (1,2,3...) papers in a given literature, c is the number of authors writing *one* paper and n is a rate. Lotka's Law is sometimes called the 'inverse square law of scientific productivity', based on the assumption that $n = 2$. Lotka's Law predicts that the number of authors making two contributions is about one-quarter of those making one; the number making three contributions is about a ninth, and so on.

The empirical straight-line relationship found suggests that the fit with Lotka's Law is good. The exponent n provides an indicator of the concentration of author contributions to the bibliography: lower values of n are associated with concentrations of authors who have multiple papers. Average productivity is thus greater since more papers are distributed over relatively fewer authors. Nicholls (1988) conducted a series of experiments on 100 data sets in an empirical investigation of Lotka's Law. The comparative data in Table 8 are drawn from the work of Nicholls and relate to his findings for first-named authors.

These findings suggest that information policy sits somewhere between the natural and social sciences in terms of author productivity.

Patterns of collaborative authorship can offer further insights into the cognitive, social and institutional organisation of a discipline. In some fields, publications are likely to bear the names of two or more authors; in others, sole authorship is the norm. On the face of it, an individual academic's reputation is likely to be most decisively established if the person concerned takes full, unambiguous responsibility for his or her own work. There are however some very good reasons for co-authoring publications. In some areas of 'Big Science', the scale and complexity of the experiments and the limited availability of apparatus is such that working in teams is the only realistic strategy. Similarly, certain highly multidisciplinary problems in the social sciences may necessitate a division of labour. A study of collaborative patterns of working in four areas of the social sciences (sociology, psychology, economics, political science) by Fox and Faver concluded that division of labour is the most common strategy for:

> ... routine research activities, those under time pressure, and those demanding complementary competencies ... [but] more complex tasks may benefit from some combination of sharing and separating the parts (Fox & Faver 1982, 336).

Of course, a precondition for working collaboratively is that the people concerned can broadly agree how to tackle the problem at hand:

> In taxonomy it's virtually impossible to work with other people – like judges, taxonomists can give opinions but they don't give joint opinions (anonymous informant quoted in Becher 1989, 98).

Similar considerations may well apply to questions of information policy, which by their very nature are often of a highly political and sensitive nature. The incidence of multiple authorship in the test collection is indeed low, as the distribution in Table 9 shows.

The low incidence of multiple authorship in the information policy bibliography (15.6 per cent) is broadly similar to patterns that have been observed in the general library and information science literature [10].

Table 10: Trends in Author Collaboration

Time period	n	Mean authors / article
1972–76	41	1.10
1977–81	100	1.24
1982–86	163	1.20
1987–91	197	1.28
1992–1996	270	1.29

In recent decades the incidence of multiple authorship has increased significantly across virtually all disciplines which have been investigated. According to figures released by the *Institute for Scientific Information* (cited in Cronin, Davenport & Martinson 1997), the average number of authors per article in *Science Citation Index*® has increased from 1.84 (1966) to 3.67 (1995). The equivalent figures for the *Social Sciences Citation Index*® are 1.15 and 1.74. Information policy seems to be an exception to this trend: the mean number of authors per paper has not changed significantly over the period 1972–96 (Table 10).

The overall mean is quite low compared to the *SSCI* population as a whole and this may possibly be indicative of the weak institutionalisation of the field of information policy. It may also be a reflection of the often speculative and philosophical nature of the subject content.

One way of looking at disciplines or fields of study is to look not at the activities of individual authors but at the institutional arrangements that support and encourage their research. There may be doubts, for example, whether statistics is now sufficiently separate from its parent discipline, mathematics, to constitute a discipline in its own right. The answer will depend, in part, on the extent to which institutions recognise the terms of their organisational structures and, in part, on the degree to which a freestanding international community has emerged with its own professional associations and specialist journals. The degree of institutionalisation of a field of studies is thus an important indicator of its maturity and status. Intense debates often surround the establishment of new forms of institutionalised knowledge production (such as queer studies, peace studies or parapsychology), whose intellectual validity may well find itself under attack from established academic opinion.

A comprehensive explanation of how fields of study become recognised and institutionalised lies well beyond the scope of this paper and would require the development of a systematic framework for understanding the mechanisms which lead to the emergence of autonomous, self-generating research structures. The analysis of corporate authorship presented here has more modest aims: to develop a broad-brush picture of the degree to which institutions, rather than individuals, feature in the production of knowledge in information policy.

Table 11. Dispersed Base of Knowledge Production

Sector	Percentage of articles in the test collection
Library profession	11
Pressure groups	9
Information industry	14
Government	20
Universities	46
Total	100

An interesting finding of this paper is that knowledge production in information policy is more heterogeneous than is commonly realised and that much research takes place outside of the traditional academic setting. This view receives strong support from the evidence presented in Table 11.

This Table assigns each record in the test collection to a single institutional category based on the corporate address of the first-named author. In terms of the number of identifiable institutions, universities account for less than half of the total, suggesting that information policy research is heterogeneous and institutionally dispersed.

Gibbons and others (1994) argue that socially dispersed knowledge production is one characteristic of a knowledge-based society. They also acknowledge that the forces that shape the relative concentration or dispersal of research activity are complex and that there are vectors acting in both directions. This raises some interesting questions. In information policy, are all sectors equally dispersed, or are some more concentrated than others? Over time, has information policy research become more, or less, associated with institutions rather than individuals?

Conclusions

In many ways, the profile of the information policy test collection that emerges from this study challenges some of the assumptions about the

Table 12. Comparison of Article / Journal Density with other Studies

Bibliography	Density
Lubrication (a)	2.41
History of psychology (b)	3.86
Mast cell (c)	4.05
Geophysics (a)	4.09
Articles citing Kuhn (b)	4.20
Rowlands' test collection	*4.26*
Schistosomiasis (c)	5.70
Human eyeblink conditioning (b)	6.76
Pavlovian conditioning (b)	8.77

(a) Bradford 1934.
(b) Coleman 1993.
(c) Goffman and Warren 1969.

behaviour of social science literatures that are commonplace in writings on bibliometrics.

The pattern of growth in the test collection is not unusual. It conforms to a power model and appears to be doubling every six years. This is, however, a more rapid pattern of growth than that of the *Social Sciences Citation Index*® as a whole, with the implication that information policy is commanding greater attention from authors and editors alike.

In Price's typology, the test collection would provide a very good example of a highly immediate or 'ephemeral' literature, of the kind commonly observed in the natural sciences. Referencing practices in information policy draw more heavily on recent material than might be anticipated from Price's simple probabilistic model, the relatively small size of the archive notwithstanding. This finding is given added weight by the rapid ageing of information policy citations (with a half-life of only three years), another indicator that might be held to be more typical of the natural sciences. This may support the view that information policy is essentially a set of problem-solving rather than academically motivated activities, driven primarily by external social need. An alternative, but related explanation is the suggestion by Cozzens (1985) that high levels of immediacy may be encountered in disciplinary areas that are undergoing revolutionary, paradigmatic change.

As might be expected for a bibliography representing a 'word-specialty', articles on information policy exhibit a spread across a large number of journal titles. It would be very tempting to characterise the information policy literature as showing a high degree of documentary scatter.

Coleman (1993) argues that article / journal densities offer a reasonably good indication of documentary scatter: the lower the density, the more thinly spread the distribution of articles across journal titles. The comparative data in Table 12 suggest that the information policy bibliography is actually *less* thinly spread than such classic literatures as Goffman and Warren's mast cell or Bradford's lubrication articles. No conclusion is suggested here, merely the observation that the test collection does not appear to be unusually highly scattered.

Another striking finding is the very low incidence of collaborative authoring. The mean number of authors per paper is significantly lower than the corresponding figure for *Social Sciences Citation Index*® as a whole (1.22 and 1.74 respectively, for 1995). In this respect, authoring behaviour more closely resembles that of scholars in the arts and humanities. Unlike many other social science disciplines which have seen an increase in collaborative authorship over the past twenty years, the low levels encountered in the appear to be a structural feature of the literature. It is difficult to interpret this finding since a number of factors may be influential: the weakly institutionalised nature of the field within higher education, perhaps, or the lack of research funding, or it may simply be a distinctive feature of cognitive style.

Notes

1. In a 1983 study of five abstracting & indexing services covering aspects of the library and information science literature *(Library & Information Science Abstracts, Information Science Abstracts, Computer & Control Abstracts, Referativnyi Zhurnal Informatika, and Bulletin Signaletique)*, Bottle and Efthimiadis (1984) found that the overall proportion of English language materials was 71.1 per cent. The article claims that similar patterns of distribution of the English language obtain in the social and natural sciences.
2. In a systematic search for articles containing the phrase 'Information Society' in four abstracting and indexing services *(Information Science Abstracts, Social Sciences Citation Index*® contributed, *INSPEC* and *Arts & Humanities Search)* Duff (1995) found that *Social Sciences Citation Index*® contributed 58 per cent of all the references recovered. *INSPEC* yielded a slightly higher proportion of unique references than *Social Sciences Citation Index*® contri-

buted, from which Duff concludes that "it would appear that the social implications of developments in computing and telecommunications technologies are now being contemplated, not only by information professionals and social scientists, but also by researchers in the so-called hard sciences".

3. Linear regression model (R^2 = 0.927).
   $y = 3.484x + 8.874$
4. Kajberg (1996) examined four Danish library journals over the period 1957–86 and returned a value for the 'Windsor ratio' of 20:80.
5. Egghe and Rousseau (1995) observe an ambiguity in relation to how Price's index is calculated in the published literature. Some authors notably Price, state that they use 'the first five years'. In this terminology it is unclear whether the year of publication, *d*, is year zero or year one. Moreover, it is unclear whether or not this year is included. In this paper, Price's index is calculated conservatively on the basis that $d = 1$.
6. For example, Small (1977) found that immediacy rose during a 'mini-revolution' in collagen research. Sullivan, White and Barboni (1977) demonstrated a similar phenomenon during a period of rapid theory change in the physics of weak interactions. Dean (1980) found that psychologists generally cited papers about seven years old: however, this dropped sharply during the period when additivity theory was displacing inhibitory theory as the dominant explanation for the probability of a conditioned response. Price's index declined to its normal rate only after the after the controversy had been resolved.
7. In the typology of Glänzel and Schopflin (1995), this is characteristic of a 'Type III' ageing process, and may be indicative of a bibliography which is heterogeneous in respect of its reception and obsolescence characteristics.
8. Linear regression model (R^2 = 0.937).
   $R(n) = 29.79 \log r + 172.23$
9. Third order polynomial model (R^2 = 0.997).
   $R(n) = 0.381(\log r)^3 - 9.673(\log r)^2 + 77.412$
10. In a study of the library and information science literature, Bottle and Efthimiadis (1984) noted a range of authorship patterns from relevant abstracting and indexing services for 1983. Their estimates of multiple authorship range from 19.1 per cent *(Computer & Control Abstracts)* to 36.6 per cent *(Information Science Abstracts)* with an overall mean of 30.8 per cent. The work of Bottle and Efthimiadis was not restricted to the journal literature, nor is it comparable in terms of its time frame with the results reported here. Raptis (1992), in a study of 39 British and American library science journals (1950–75), found that 13.6 per cent of articles were multiple-authored.

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