
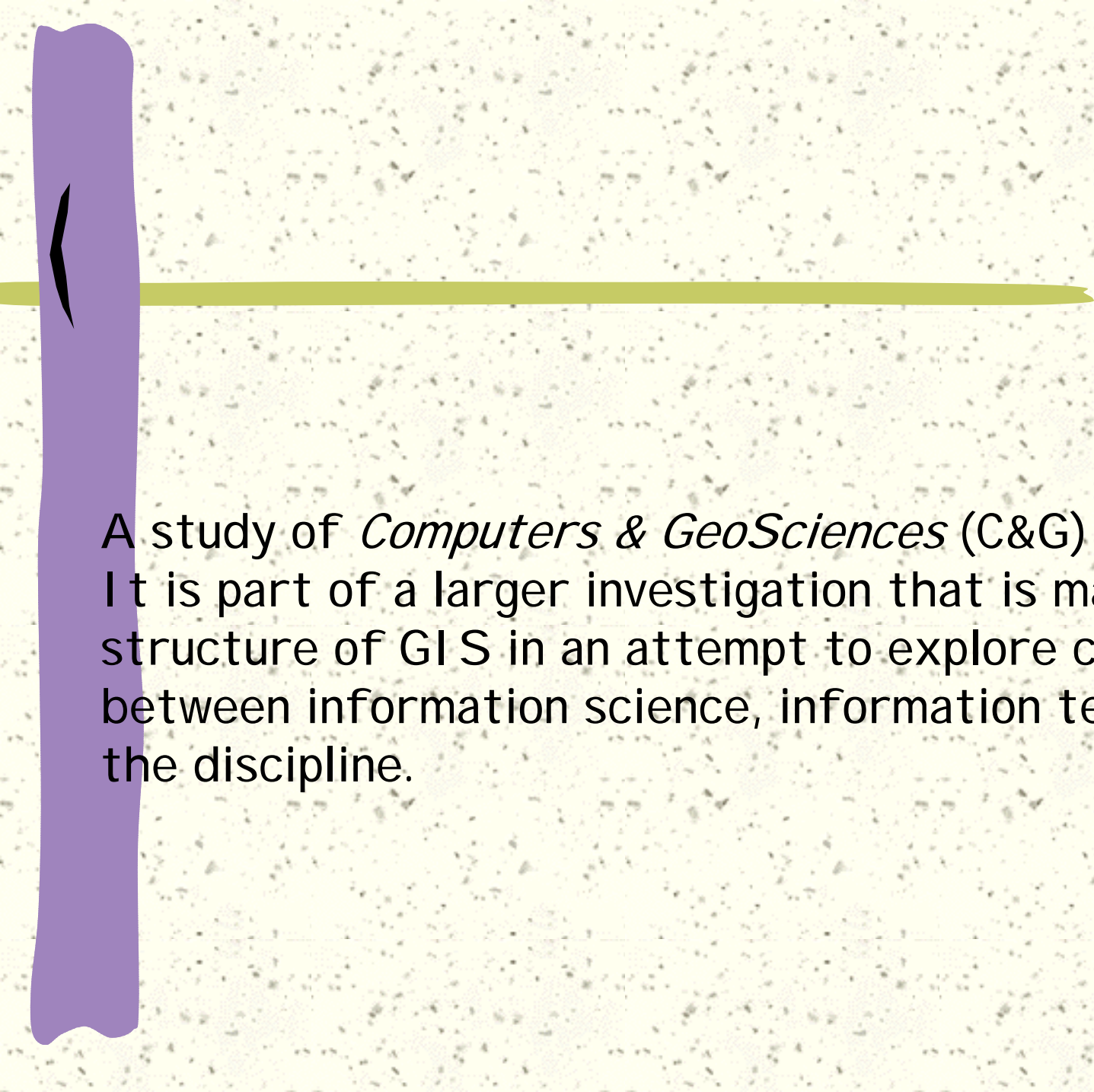


Mapping the Intellectual Structure of Information Science and Information Technology: A Study of Geographic Information Science



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A study of *Computers & GeoSciences* (C&G) is discussed. It is part of a larger investigation that is mapping the structure of GIS in an attempt to explore connections between information science, information technology and the discipline.

Acknowledgements

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What is GIS?

- # Geographic information system
 - 1960s term coined by Tomlinson for the Canadian government
- # Geographical information science
 - 1990s term coined by Goodchild
 - Disciplines include: Photogrammetry, Remote sensing, Geodesy, Cartography, Surveying, Geography, Computer Science, Spatial statistics, and other disciplines with interest in spatial data
- # NSF-funded NCGIA (1988) to UCGIS (1991)

According to UCGI S

- # Cartography
- # Cognitive Science
- # Computer Science
- # Engineering & Land Surveying
- # Environmental Sciences
- # Geodetic Science
- # Geography
- # Landscape Architecture
- # Law and Public Policy
- # Remote sensing and photogrammetry
- # Statistics

Controversy in GIS

1997 forum, *Annals of the American Association of Geographers*

- Wright, Goodchild & Procter summarize an Oct.-Nov. 1993 debate on GIS-L
- Debate on: Is GIS a tool or a science?

NSF NCGIA Initiative 19

- The Social Implications of How People, Space and Environment are represented in GIS

Components of GIS

- # Hardware/Software components
- # Conceptual elements
 - Rules governing the creation of spatial models
 - Measurement and modeling of error propagation through a GIS
 - Proofs of theorems on data structures
- # Spatial Data

Views on GIS

- # Geography is the science (not GIS)
 - Academic Wars: No Geog. Dept. at Harvard
- # The science label is to attract money
 - Science is used as a generic synonym for research
 - Code-phrase for academic legitimacy
 - 'Big science'
- # Who is involved (salesmen and students recognize it as a tool; developers see it as science)

The I S-I T triumvirate suggested by G I S

GIS as tool

- Use of a particular class of software, associated tools, digital geographic data

GIS as toolmaking

- Advancing the tool's capabilities and ease of use

GIS as science

- Research on a basic set of problems that previously existed but is now made more urgent because of the technology

Critical theory of GIS

Sui (1994)

- # Ontology

- # Epistemology

Alternative ways of representation

- # Methodology (Praxis)

- # Ethics

- # Politics

A Review of the literature

- # Buckland (1999) urges not to argue what information science means; rather look at hot topics like GIS
- # Ellis et al (1999) examined the nature of relationships between Information Science and Information Systems
 - Examined the literature in User Studies & IR
 - Concluded that these are “conjunct subjects & disjunct discipline”

Disciplines

- # Disciplinary cultures produce (Schoenberger)
 - Objects and methods of study
 - Credentialed practitioners
 - Values and ways of knowing
- # Multidisciplinary Information Science
 - Summers et al (1999) about Loughborough
- # Still at the Frontier: IS at the Millenium (Brookes, 2001)

Disciplinary maps and structures

- # Morris and McCain (1998) and Morris (2001) found that Medical Informatics had weak links to information science literature.
- # Classification codes and descriptors are serve as identification markers to the scientific paper rather than author. Braam, Moed, and van Raan (1991)

The I S-I T-LI S triumvirate

LIS as tool

- Use of library catalogs, search engines, digital libraries

LIS as tool-making

- Advancing the capabilities of catalogs, ease of use of digital libraries

LIS as science

- Research on a basic set of problems for example, how well do our information handling tools mirror the knowledge structures of societal groups, individuals

Summary of methods used: Data collection & analysis

Journal selected

■ Computers & GeoSciences

- GIS journals: American Cartographer, Annals of the Association of American Geographers; Cartography and GIS; International Journal of GIS; IEEE Transactions on GeoScience and Remote Sensing

Time periods & Authors selected

- 1998-2002 & 1978, 1988, 1996

Co-citations & Descriptors analysis

Data collected

Sources:

- Journal: *Computers & Geosciences*
- Databases: *ISI, GeoRef*

Data collected includes:

- Article citations - IAMG (~2000)
- Index descriptors & Class codes - GeoRef
- Citation data (Times cited) - ISI

Computers & Geosciences

- # Publisher (Sponsor): International Association for Mathematical Geology (IAMG), Canada
- # Publisher: Pergamon-Elsevier
- # Frequency: 10 issues per year
- # Starting Date: July 1975
- # Editors: two
- # Circulation: 1100

History of C&G

- # Current goal: 'international journal devoted to the publication of papers on all aspects of geocomputation and to the distribution of computer programs and test data sets.'
- # Earlier goal: "rapid publication of programs in widely used languages and their application"

I AMG

Office:

- 4 Catarqui St. Ste. 310, Kingston, ON, Canada K7K 1Z7

President:

- Dr. Graeme Bonham-Carter

History:

- Founded: 1968
- Members: 525

IAMG

- # Professional geologists, mathematicians, statisticians, and interested individuals. Promotes cooperation in the application and use of mathematics and statistics in geological research and technology. Affiliated With: American Association of Petroleum Geologists; International Union of Geological Sciences.
- # Refereed publications: *C&G*, *Mathematical Geology*, *Natural Resources*

Geosciences includes

- # Geology
- # Geophysics
- # Geochemistry
- # Geomathematics
- # Oceanography
- # Environmental science
- # Hydrology
- # Geography
- # Remote sensing
- # Geographic information *systems*

GIS Journals

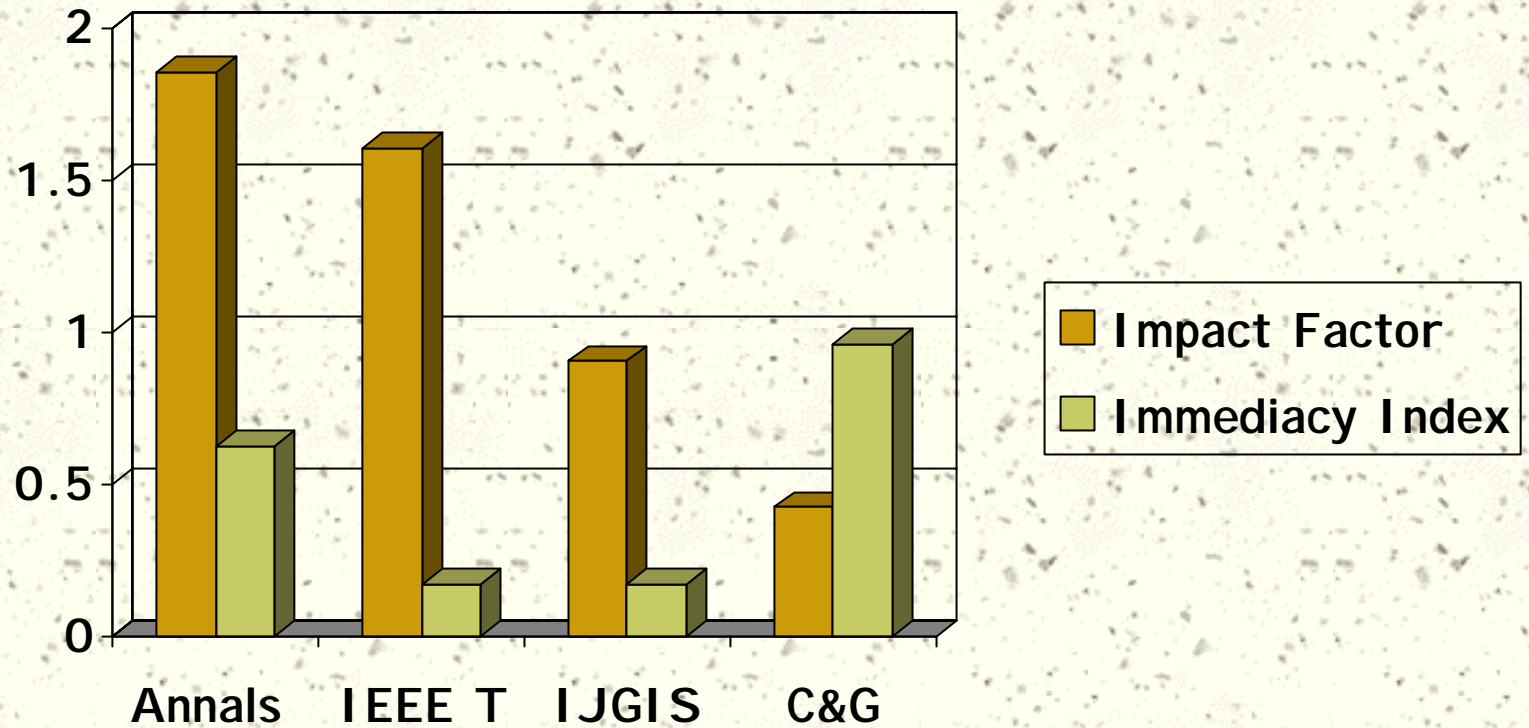
International Journal of Geographical Information Science (IJGIS)

IEEE transactions on Geoscience & Remote Sensing

Annals of the American Association of Geographers (Annals)

Cartography & GIS

Impact & Immediacy



Document types

- # Programs - source code
- # ANON
- # Statistics
 - Most downloaded articles
 - Number of downloads for software (annual list, 2001, 2003)

Document types (1998-2002)

Annual Mean: 116.6

Article

Annual Mean: 0.8 – 0.2

Bibliography

Biographical – Item

Correction

Editorial Material

Letter

Review

Annual Mean: 1.2

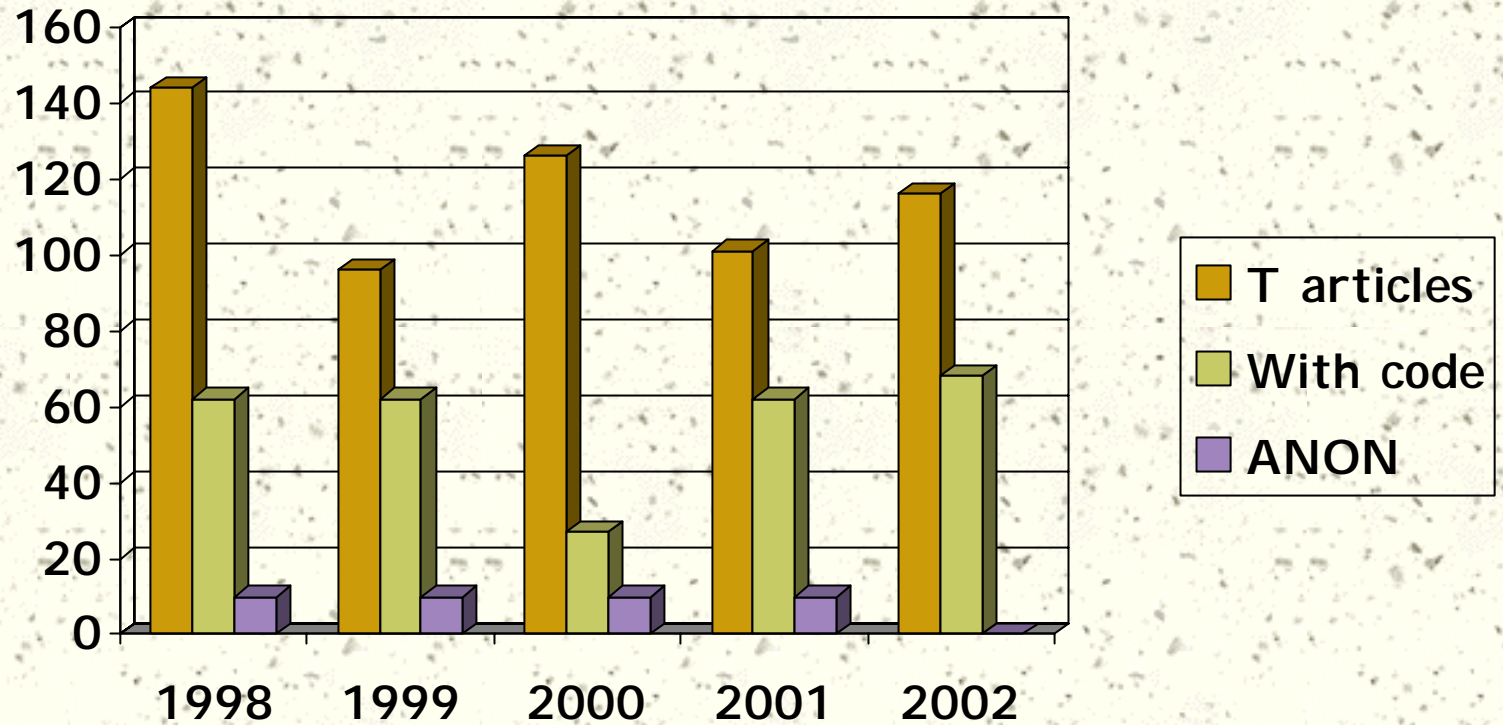
Software Review

Annual Mean: 0

Database Review

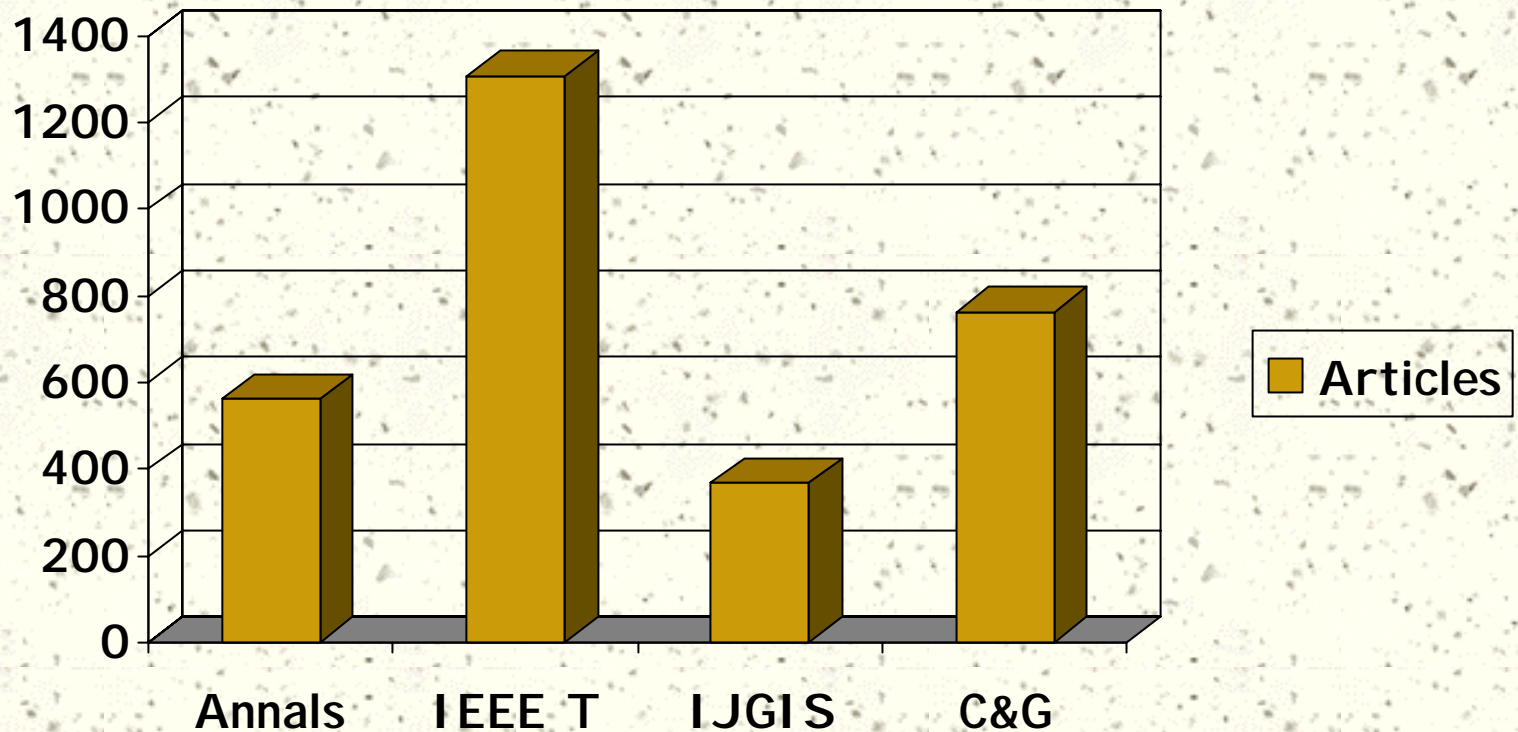
Hardware Review

Document types & Frequency



Comparisons with other journals

- number of articles published (1998-2002)



Sample authors:

Goodchild MF

87 articles

- 59 are cited at least once
- Most times cited: 70

2 articles in C&G

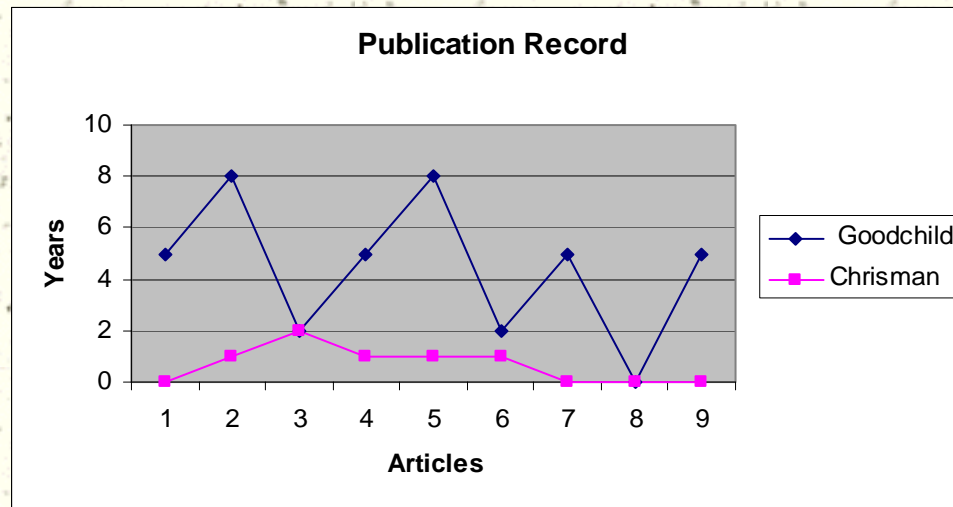
- 1992 pub. Cited 42 times
- 1997 pub. Cited 8 times

Chrisman, N

7 articles

None in *C&G*

Sample authors



Sample titles (1975)

- # # 1: PIP1 and PIP2: FORTRAN IV programs to aid in the determination of important parameters in a classification scheme (tool)
- # #2: Classification of glacial tills by computer using the CLUS program (toolmaking)
- # #3: A computer simulation and study of grain shape (science)

Descriptors & Class codes (GeoRef)

#1:

Automatic data
processing

General-

Programs-

Classification-

Parameters-

Fortran IV

15 - Miscellaneous
and mathematical
geology

- Bibliography

- General
mathematical
principles

518 C&G articles in
this category out of
a total of 1987

Sample descriptors

ISI (author supplied)

modeling

data processing

visualization

graphical user
interface

interactive

Geo-physical
techniques

geo-physics
computing

Sample results

1978

XLFRAC; a program for the interactive testing of magmatic differentiation models

Author keywords: data processing

Times Cited: 198

CC: 05 (Petrology-Igneous and metamorphic)

9 Refs.

1998

Gstat, a program for geostatistical modelling, prediction, and simulation

Author keywords: GIS

Times cited: 39

Downloaded: 163

CC: 15 (Miscellaneous & mathematical geology)

37 References

Results

Tool

- # Programs
- # Algorithms
- # Methods
- # Solution

Toolmaking

- # Education
- # Participatory processes
- # Usability

Science

- # Place or feature +
- # Phenomena +
- # Discipline
- # Problem (MAUP, ecological fallacy)

Questions



Usefulness of descriptors from citations and cited references as maps of the literature or as visualizations of disciplinary structure

Indicators of IS-IT and disciplinary concepts from descriptors and context

Resources

Websites

GIS History Project (UCSB)

Unpublished bib.; Update: 1997

NCGIA Core Curr. (1997-2001)

Goodchild, MF. What is GIS?

LIS Learning Showcase

IRLS 589 (Spring 2003) class
GIS bibliometrics studies

NCGIA Initiative 19 Position Papers

Three core I-19
conceptual issues:

- 1) epistemologies of GIS;
- 2) GIS, spatial data institutions, access to information; and
- 3) developing alternative GISs

References

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Audience-Panel discussion

Thanks to audience members who responded to my Qs. Summary:

Comment: The reason this research finds it difficult to map GIS is because there is no coherent core for geography; no core set of journal literature for either Geography or GIS. NRC recently recommended the elimination of geography as an academic department in all US universities. [see my next slide too]

Discussion: Bradford's law must indeed be attended to; but, bibliometrics should also study literature scatter because increasingly disciplines are inter or multi-disciplinary (and with no coherent cores). Moves bibliometrics into the second and third stages (referred to C. Wilson's presentation)

Q.: How can bibliometrics methods map literatures of disciplines that have no coherent core?

A. Citation analysis methods only show one part of the picture; must always be supplemented by other methods to get the whole picture.

Additional resources

I searched on the WWW for the recent NRC document that the gentleman in the audience mentioned as having recommended the elimination of geography depts in the US. I found this:

Committee on Research Priorities in Geography at the U.S. Geological Survey, Committee on Geography, National Research Council. *Research opportunities in Geography at the USGS. NAP, Washington, D.C., 2002*

URL: <http://www.nap.edu/catalog/10486.html>