READING LIST:USING A RETROSPECTIVE APPROACH TO MINE THE LITERATURE FOR GIS AND GISCIENCE NUGGETS

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Mining U.S. Federal Agency Materials for GIS and GIScience Nuggets

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1. Background to the Seminar Reading List

Details about GIS retrospective program objectives have been presented previously in several documents. However, it is possible that not all readers have accessed these materials. As a result, to assist in putting everyone reading this document on the same page, I open the Background section with a brief summary statement about GIS retrospective program objectives, and include links to several pertinent reports for those who want to learn about the derivation of the objectives and related matters.

The following remarks appear sufficient to achieve a common understanding of the objectives of the GIS retrospective program.

First, and consistent with a primary axiom of methodologically designed inquiries, the GIS retrospective research project is organized around a question:

> ***How can looking back at what has been done, or not been done in the field of geographic information systems (GIS), contribute insights into why and how the field of GIS could and should evolve in the coming years?***

With that question providing an overall sense of purpose, the reading list prepared for the 2016 seminar is another step in the process of elaborating what we can learn from the past, and how we can learn from the past, to inform the futures of three core, related missions:

1. **Designing, developing, and implementing geographic information systems (GIS) technology;**
2. **Defining and elaborating the research methods, techniques, and operations of geographic information science (GIScience); and**
3. **Using geographic information systems technology and/or geographic information science in government, academia, business, the media, and other organizations, as well as by individuals, community associations, and other interests.**

Information about the derivation and discussion of the objectives of the GIS retrospective program is presented in a number of publications, which can be accessed via the following links:

http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf; **http://wellar.ca/wellarconsulting/IJAGR_AC_SixRetroReviewAndImplicationsPaper.pdf**; **http://wellar.ca/wellarconsulting/COLLOQUIUM_PROCEEDINGS.pdf**; **http://wellar.ca/wellarconsulting/COLLOQUIUM_SLIDE_PRESENTATIONS.pdf**; **http://wellar.ca/wellarconsulting/Summary_GIS_Retrospective_Research_Colloquium_FINAL.pdf**; and, **https://www.esri.com/esri-news/arcnews/summer15articles/colloquium-urges-gis-specialists-to-look-to-the-past-to-inform-the-future**.

The decision to include a reading list in seminar materials follows comments and suggestions arising from the Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets, which was held at Esri in Redlands, February 13-14, 2015.

In brief, the idea of using the retrospective approach to mine the literature for GIS nuggets was seen to introduce research design issues that are a major departure from prior experience for many in the GIS and GIScience community. It was recommended that I provide a selected body of publications to assist seminar attendees and other interested parties better understand the seminar objectives and presentations, and more comfortably participate in Q&A sessions and post-seminar discussions.

Based on prior reading list projects, I believe that for a new or significantly different research activity such as this one on using the retrospective approach to mine for GIS nuggets, it is advisable to begin at an indicative level, with emphasis on being broadly illustrative rather than deeply comprehensive. Moreover, it is advisable to limit entries to those which could be deemed original, fundamental, or basic building blocks. Additional readings can be added as time and resources permit, or circumstances dictate.

For the purposes of this seminar, four bodies of pertinent readings are identified.

First and foremost are the papers prepared for ***AutoCarto Six Retrospective*** (section A), which set out many of the concepts, ideas, needs, challenges and opportunities, as well as principles and practices that underlie the evolution of GIS technology and GIScience methodology.

The second body of publications is the papers and slide presentations prepared for the Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets (section B1 and section B2, respectively), and the third body (section C) consists of the articles about GIS retrospective project activities published in the *International Journal of Geospatial Research (IJAGR)*.

These materials are what might be termed “required reading” .for the seminar. I do not believe that they are sufficient for a number of attendees, but I do regard them as necessary in order to more fully benefit from seminar presentations and the discussions.

Finally, a preliminary list of publications (section D) from various academic, government, professional organization, and other sources has been compiled to supplement the ***AutoCarto Six Retrospective*** papers, and the colloquium productions. It is anticipated that more references will be identified in the coming months, and the current reading list dated July 31, 2015 will be amended accordingly.

Again, the intention is to suggest readings which could be instructive for a wide range of attendees, and our approach at this stage in view of resource constraints, as well as uncertainty about the backgrounds of seminar attendees, is to be indicative and illustrative rather than comprehensive and directive.

2. Papers from *AutoCarto Six Retrospective*

In this first-of-a kind publication, 38 authors re-visit themes that they wrote about 30 years previously in papers for the Sixth International Symposium on Automated Cartography, held in 1983.

Many of the authors of papers in 1983 were already established contributors to the literature on GIS and GIScience, and over the next three decades they went on to have distinguished careers and become leaders in various aspects of GIS and GIScience.

It is instructive to read their comments about the value of retrospectively examining what they were thinking, doing, and writing in years past, and about the importance of making connections between past, present, and future activities in GIS and GIScience.

Authors and titles of papers in *AutoCarto Six Retrospective* are presented in section A.

SECTION A

Papers and Authors, *AutoCarto Six Retrospective*

	Introduction to *AutoCarto Six Retrospective*	*Jack Dangermond*
1	Design of *AutoCarto Six Retrospective*	*Barry Wellar*
	PART I: KEYNOTE AND PLENARY SESSION PAPERS	
2	Early Thoughts about Automated Mapping in an Information Society	*Barry Wellar*
3	The Evolution of an Operational GIS	*Ian Crain*
4	Linking Information Society, Geography, and Decision Support Systems and Services	*Barry Wellar*
	PART II: GENERAL SESSION RETROSPECTIVE PAPERS	
5	Introspective View of Toronto's AutoCarto Six Paper	*Ralph Smith*
6	Looking Back at the Feasibility and Prototype of the Product Market Matching (PMM) System for Tourism Planning and Development	*Bernie Campbell and Giulio Maffini*
7	The Long-term Functioning of Geographic Information Systems	*Nicholas Chrisman*
8	From Generalisation and Error to Information Overload and 'Big Data'	*Mike Blakemore*
9	Whatever Happened to the Statistical Surface?	*Barbara Buttenfield*

10	Exploratory Steps towards the Contemporary World of Geographic Information and Unexpected Consequences	*David Rhind*
11	Design of Maps for Telidon: Interactive Design of Maps Revisited	*Fraser Taylor*
12	MIGS: From Cartographic Revolution to Evolution	*Steve Prashker*

PART III: SPECIAL SESSION RETROSPECTIVE PAPERS

13	L'évolution de la cartographie thématique sur micro-ordinateur	*Jean-Paul Donnay*
14	LACAD: Looking Back and Looking Forward at Simulating and Visualising the Real World	*Bob Itami and Randy Gimblett*
15	Adaptive Grids Then and Now	*Randolph Franklin*
16	Fractals in Context: Fractal Enhancement for Thematic Display of Topologically Stored Data	*Marc Armstrong and Lewis Hopkins*
17	Soil and Agricultural Land Maps, from Mapping to GIS	*Jean-Philippe Grelot*
18	Fractals 30 Years After: A Retrospective of "Measuring the Fractal Dimensions of Surfaces"	*Mark Shelberg, Nina Lam, and Harold Moellering*
19	The Photogrammetric Generation of Topographic Information: A Brief History	*Dierk Hobbie*
20	The Map Overlay and Statistical System (MOSS) – A Historical Perspective	*Carl Reed*
21	Automated Cartographic-Quality Map Feature Labeling	*John Ahn and Herbert Freeman*
22	Technology, Information, Communications and Instant Maps	*Chris Kissling*
23	Early Electronic Atlases - Synergy between the Classical and Modern Cartography and GeoVisualization	*Eva Siekierska*
24	Moonshot – USGS and Census Build TIGER	*Steve Guptill*
25	Reflections on Data Transfer Between Software Environments and the Challenges of GIS Teaching in a Post-Secondary Institution	*Robert Maher and David Colville*

26	A Retrospective on Designing Interactive Spatial Systems Based on Real and Virtual Maps	*Harold Moellering*
27	Big Data: How Geo-information Helped Shape the Future of Data Engineering	*Robert Jeansoulin*
28	Human Factors in the Design of Real-Time Cartographic Displays – A Battle Lost?	*Michael Dobson*
29	The Class of 1980s: Contributions to Local Government GIS Implementation and Management Methods	*Rebecca Somers*
30	On the Transfer of Remote Sensing Classifications into Polygon Geocoded Data Bases in Canada	*David Goodenough and Gordon Plunkett*

Papers in *AutoCarto Six Retrospective* can be viewed at:
http://wellar.ca/wellarconsulting/AutoCarto_Six_Retrospective.pdf

3. Papers and Slide Presentations from the Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

These materials provide a context for the seminar, define what is meant by "nuggets", elaborate what is meant by "the literature", and discuss such critical topics as retrospective research methodology, the rationale for and value of engaging in retrospective research, and the value of retrospective research as a means of obtaining additional returns on such initiatives as:

- Investments in acquiring, processing, disseminating, and applying geospatial data, information, and knowledge;
- Investments in GIS technology;
- Investments in the application of GIS technology, and
- Investments in the development and application of GIScience methodology (research methods, techniques, and operations).

The authors and titles of colloquium papers and slide presentations are listed in sections B1 and B2, respectively.

SECTION B1

Papers and Authors, Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

1	Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Considerations	*Barry Wellar*
2	Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to	*Barry Wellar*

	Retrospectively Mine the Popular Literature for GIS Nuggets	
3	Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development	*Barry Wellar*
4	Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment	*Barry Wellar*
5	Mining Open Data in Search of GIS Nuggets	*Gordon Plunkett*
6	Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research	*Mike DeMers*

Research colloquium papers may be viewed at:
http://wellar.ca/wellarconsulting/COLLOQUIUM_PROCEEDINGS.pdf

SECTION B2

Slide Presentations and Authors, Research Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets

1	Fundamentals of Mining for GIS Nuggets: Introductory Remarks	*Barry Wellar*
2	Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Initial Design and Module Considerations	*Barry Wellar*
3	Developing a Compendium of Ideas on Using the Retrospective Approach to Mine for GIS Nuggets: Populating the Questions Module	*Barry Wellar*
4	Looking Back, Looking Ahead: Industry Thoughts for the GIS Retro Colloquium	*Jack Dangermond*
5	Mining Open Data in Search of GIS Nuggets	*Gordon Plunkett*
6	Abuse v. Care of Land, Water, and Air, 1990-2015: The Doomsday Map and Stewardship Map Concepts as Compelling Arguments to Retrospectively Mine the Popular Literature for GIS Nuggets	*Barry Wellar*
7	The Role of Federal Agencies in Directing the Research Agenda: Is this a Case of the Cart Before the Horse? A TIGER Case Study	*Tim Trainor*
8	Searching for GIS Nuggets: Mining Annual Reports by Canada's Commissioner of Environment and Sustainable Development	*Barry Wellar*

9	Preserving Institutional Memory: Capturing Knowledge Key to GIScience	*Stephen Guptill*
10	Mining for GIS Nuggets in Reports by Ontario's Commissioner of Environment	*Barry Wellar*
11	Extracting Nuggets – Data Quality and Metadata	*Nick Chrisman*
12	Revisiting Classical Land Classification, Assessment, and Management Literature to Inform GIS Research	*Mike Demers*
13	Integrated Land Evaluation – Story of a Track Not Taken	*Nick Chrisman*

Research colloquium presentations may be viewed at:
http://wellar.ca/wellarconsulting/COLLOQUIUM_SLIDE_PRESENTATIONS.pdf

4. GIS Retrospective Articles in the *International Journal of Applied Geospatial Research*

At this time of writing (July, 2015), the *International Journal of Applied Geospatial Research* has published two retrospective articles, and a third article has been accepted for publication in the first issue of 2016. Details are presented in section C.

SECTION C

Articles about GIS Retrospective Project Activities Published in the *International Journal of Geospatial Research (IJAGR)*

1. Wellar, B. 2014. Using the retrospective approach to commemorate AutoCarto Six. *International Journal of Applied Geospatial Research (IJAGR*). D. Albert, Editor. 5(1), 93-99.
2. Wellar, B. 2015. Review and implications of the AutoCarto Six retrospective project. *International Journal of Applied Geospatial Research (IJAGR*). D. Albert, Editor. 6(3), July-September, 73-90.
3. Wellar, B. 2016. (Forthcoming) Developing a compendium of ideas on using the retrospective approach to mine for GIS nuggets: Initial considerations. *International Journal of Applied Geospatial Research***.** *(IJAGR*). D. Albert, Editor. 7(1) Jan-Mar.

Examination of these materials may be instructive for those wishing to know more about why and how the retrospective approach was used to re-visit papers in the proceedings of the AutoCarto Six Symposium, and to then move from that base into a Colloquium on Using the Retrospective Approach to Mine for GIS Nuggets.

5. Results from Surveys and Literature Searches

In view of the modest scale of the seminar project, the survey and literature search activity is prudently of an indicative nature. The three elements of the survey and literature search activity are outlined as follows.

First, to the extent that time and resources allow, individuals and federal agencies recognized for their contributions to GIS and/or GIScience are asked to suggest published materials of a general nature (e.g., bibliographies, conference proceedings) which are likely sources of GIS and/or GIScience nuggets.

Second, to the extent that time and resources allow, individuals and federal agencies recognized for their contributions to GIS and/or GIScience are asked to suggest published materials which address matters of current or (potentially) future interest, and which are likely sources of GIS and/or GIScience nuggets.

And, third, to the extent that time and resources allow, literature searches are undertaken using keywords from *AutoCarto Six Retrospective* papers, from the colloquium papers and slide presentations, and from publications which I believe provide critical insights into connecting the past, present, and future states of GIS technology, GIScience methodology, and the uses of GIS and GIScience methodology. Publications will be added to section D until the end of December, 2015.

As readers may recall, the past-present-future connection was elaborated by the late Prof. William L. Garrison in discussions about designing the colloquium. His advice is even more pertinent for this seminar, as we think about mining materials which document 50 years and more of investments by federal agencies in GIS technology, GIScience methods, techniques, and operations, and the uses of geospatial data, geospatial information, and geospatial knowledge for legislative, policy, program, and operational purposes.

Further, while our interest is not limited to digital productions, emphasis for the seminar is on these more readily accessible publications. To the extent that assistance and resources allow, significant publications which are currently available only in paper format will be scanned and links provided for easy electronic access.

Before presenting the items obtained via surveys and literature searches, it is appropriate to outline the design of this part of the reading list.

There are various ways to organize the materials in this section, but for the purposes of the seminar I believe it advisable to list the publications in chronological order for several reasons. They are outlined as follows.

First, documenting the times and sequences of ideas, developments, and events is critical to understanding the unfolding of causal relationships during the evolution of GIS technology, GIScience methodology, and the uses of GIS technology and GIScience methodology. This is a difficult task, however, because we are dealing with a diverse body of subject matter that has a publishing history of 50 or so years, and by no means

is the publishing record a precise match for the actual creation, discovery, etc., of ideas, or the unfolding of developments and events.

That said, this is a very modest project, and under the circumstances a time-ordered list is a reasonable and relatively effective means to track publication topics and authors, and to contemplate past-present-future connections.

Second, carefully examining previous thinking and doing in GIS and GIScience, and the uses of GIS technology and GIScience, could yield findings (a.k.a. nuggets) which significantly contribute to present and future thoughts and deeds in GIS, in GIScience, and the uses of GIS and GIScience in government, academia, business, etc.

Readers who have examined the published record as part of the background work for dissertations, theses, project proposals, creation of legislation, development of policies, public hearings, etc., are already aware from direct experience that the retrospective approach is a matter of record.

However, as a general rule that work was done on an individual or small-group basis, and what we have in mind for the seminar is very different. That is, we are engaged in a much broader enterprise, in that the retrospective research is undertaken at an agency level, and could entail hundreds if not thousands of personnel. Further, an even wider level of engagement is anticipated through in-person and virtual participation in the seminar event, and as a result of subsequent discussions.

The chronological approach promotes staying on course regardless of the number of participants, but keeping track of who said or did what over time becomes increasingly important as more players become involved in mining for GIS nuggets. From the standpoint of both effectiveness and efficiency, therefore, the value of the time factor cannot be over-emphasized.

Third, although the evolution of GIS and GIScience has a relatively short span of 50 or so years, there have been a number of fundamental changes in GIS technology; in GIS education, training, research, applications, management, etc.; as well as in attitudes and actions in support of increased adoption of GIS in government, in business, and in academic institutions from elementary schools through to colleges and universities. This topic is discussed in detail in **The Emergence of Geographic Information Systems as a Core Public Policy Research Tool: Comments on the Paradigm Shift**, which was prepared as background material for the seminar.

Fundamental changes, a.k.a. revolutionary changes, are significant phenomena. It therefore makes eminent good sense to be aware of such changes, and to mine them for all they are worth as potential sources of GIS nuggets in any of the ways mentioned above.

A number of entries in section D temporally track fundamental changes in GIS technology, GIScience methodology, and their uses, and the references in those documents suggest additional readings. Of particular significance are benchmarking documents.

Finally, it was frequently noted during the AutoCarto Six Retrospective project, and the colloquium project, that unfounded claims are often made about new or different ideas, relationships, hypotheses, evidence, etc.

As pointed out in a number of communications, one seeming cause of the unfounded claims was and is a failure to do proper literature searches of both digital and paper productions.

This reading list is neither designed nor intended to address the failed literature search issue from a methods perspective, but it does provide readers a number of reasons to have due regard for both paper and digital productions when retrospectively mining the literature for GIS nuggets.

That is, references in section D go back to the early days of GIS and GIScience formation and evolution, and these references contain hundreds of additional references, all of which were initially paper productions.

Or, to re-phrase for the purpose of emphasis, published works intended for general consumption up until the 1980s were in paper format, and paper was the format of choice for many productions well into the1990s. Accordingly, there is an abundance of entries in section D which take readers back to the time when much of the original thinking about GIS and GIScience was expressed and communicated via paper.

The chronological listing of publications in section D may therefore serve a double purpose:

a. Drive home the requirement of beginning at the beginning when conducting literature searches in order to achieve a robust retrospective research design; and,

b. Ensure that mining for nuggets gets beyond derivative literature to the original literature on GIS technology, GIScience methodology, and the uses of GIS and GIScience.

SECTION D

Publications Resulting from Solicitations, Surveys, and Literature Searches

Ackerman, E. 1958. *Geography as a Fundamental Research Discipline.* Chicago: The University of Chicago.

Anderson, J. 1961. Toward more effective methods of obtaining land use data in geographic research. *The Professional Geographer.* XIII (6), 1-4.

Ackoff, R. 1967. *Scientific Methods Optimizing Applied Research Decisions*. London: John Wiley and Sons, Inc.

Hemmens, G. 1968. Survey of planning agency experience with urban development models, data processing and computers. *Urban Development Models.* ed. G.

Hemmens. Washington: Highway Research Board-National Academy of Sciences. 219-230.

Steger, W. and Lakshmanan, T.R. 1968. Plan evaluation methodologies: Some aspects of decision requirements and analytical response. *Urban Development Models.* ed. G. Hemmens. Washington: Highway Research Board. 33-76.

U.S. Department of Housing and Urban Development, 1969. *Request for Proposals No. H-2-70 for Municipal Information Systems.* Washington, DC: Department of Housing and Urban Development, Contracts and Agreements Division.

Horwood, E. and H. Calkins, 1970. Perspectives on where we have been in urban/region information systems. *Papers of the Eighth Annual Conference of the Urban and Regional Information Systems Association.* 25-34. https://library.esri.com/docs/138854.pdf

Aangeenbrug, R. 1971. An essay on the minimum requirements of a geographic information system. *Geocoding-71. Papers from the Working Session on Geographic Base File Developments.* ed. D. Cooke... Chicago, IL: Urban and Regional Information Systems Association and Urban Data Processing, Inc., 67-71.

Wellar, B. 1971. Evaluation of selected major information system research and development projects: Implications for the Wichita Falls, Texas municipal information system (MIS). *The Wichita Falls Consortium Phase I Report, Integrated Municipal Information Systems Project.* Section II, 18-138. Contract No. H-1217-Municipal Information Systems, Federal Urban Information Systems Inter-Agency Committee, U.S. Department of Housing and Urban Development. Springfield, VA: National Technical Information Service, Operations Division, U.S. Department of Commerce, NTIS No. PB-206 789-18.

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Matthews, J. and K. Kraemer. 1975. *Ten Years of URISA Proceedings: Indexes and Abstracts.* Washington, D.C. Urban and Regional Information Systems Association.

Horwood, E. 1977. Perspectives on URISA's origin and on the emergence of a theory of urban and regional information systems. *Information System Inputs to Policies, Plans, and Programs*, *Papers of the 15th Annual Conference of the Urban and Regional Information Systems Association* , ed. B. Wellar. Vol. 1, Invited Papers. 2-19, https://library.esri.com/docs/139550.pdf

Kevany, M. 1977. Review: 15 Years of URISA geoprocessing. *URISA Annual Conference Proceedings* ed. B. Wellar. Vol. II. 126-134.
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Information Systems and Services in Local Governments. ed. B. Wellar. URISA Conference Proceedings. McLean, VA: Urban and Regional Information Systems Association. Vol. III, 82.88. https://library.esri.com/docs/139667.pdf

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Wellar, B. 1990. Science, applications, coherence and GIS; Seizing the moment. *GIS/LIS Proceedings.* Vol.2. 854-871.

Wellar, B., D. Parr, and R. Somers. eds. 1990. *Introduction to Geographic Information Systems.* Washington, DC: Urban and Regional Information Systems Association.

Wellar, B. 1991. Standards and IS/GIS, 1971-1991: Is the relationship getting better, or just older? *URISA Annual Conference Proceedings*. Vol. 5. http://urisa.library.esri.com/cgi-bin/koha/opac-detail.pl?biblionumber=133317&query_desc=au%2Cwrdl%3A%20wellar

Goodchild, M. 1992. Geographical information science. *International Journal of Geographical Information Systems*. Vol. 6, No. 2. 87-104.

Smith, R. & Wellar, B.1992. A progress report on public policy objectives achieved through IS/GIS/LIS. *IS/GIS/LIS and Public Policies, Plans and Programs: Thirty Years in Perspective. Eds.* Wellar, B., and Parr. Papers from the Annual Conference of the Urban and Regional Information Systems Association. V, 117-144. https://library.esri.com/docs/3571.pdf

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6. Next Steps

The reading list will be updated prior to the seminar as called for by circumstances, and as time and resources allow.