Electronic Documentation at ICPSR: Migrating to a Standard Format

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In its more than 35-year history, the Inter-university Consortium for Political and Social Research (ICPSR) has gained a reputation for ensuring the usability, integrity, and long-term preservation of social science data sources and technical documentation. Indeed, many users look to ICPSR to provide the “Good [Data] Housekeeping Seal of Approval” for research materials as they conduct their secondary analyses. The evolution of technical documentation at ICPSR reflects this emphasis on quality and on user needs, and illustrates the types of issues that archives face as they migrate resources to alternate formats in response to shifts in technology.

Early Experience at ICPSR

ICPSR has received study documentation in varying formats over time. Early documentation primarily consisted of duplicated paper documents supplied by principal investigators. These paper documents ranged from mimeographed copies, annotated with scribbled notes in long-hand, to highly formatted, professionally printed government publications. Depending on the research potential of the studies they documented, some of the poorer quality materials were rekeyed and then distributed as electronic files. In addition, ICPSR created some documentation itself by using coding analysts to do text entry.
In the late 1960s, ICPSR and many in the social science research community adopted the OSIRIS statistical package, which soon became the standard processing model for ICPSR. OSIRIS “tagged” codebooks were uniform in format and could be printed using most mainframe systems and the commonly used text packages of that era. During this period, users still relied heavily on print; although codebooks for ICPSR’s intensively processed studies were available in machine-readable form (codebook-listed-to-tape), the documentation was also printed and bound like traditional books.

As support for the OSIRIS standard waned in the 1980s and data producers became more adept at processing and cleaning data, ICPSR began to release more data and documentation “as is,” with a minimum of processing. Ironically, while an increasing number of data producers, including those in the federal government, were producing technical documentation using word processing packages, the majority of the documentation being deposited at ICPSR was still in paper form. Users were beginning to express a preference for electronic documentation that could be searched and manipulated. ICPSR pursued several strategies to obtain producers’ original machine-readable materials, but these efforts were largely unsuccessful.

With the advent of FTP capabilities, the need for electronic documentation took on an added urgency. When data files could be transferred across the globe in a matter of minutes, it no longer made sense for users to wait for hardcopy codebooks to arrive in the mail. Consequently, ICPSR began to explore the use of scanning technology to convert incoming paper documents to electronic form and to digitize its backlog of paper. ICPSR began using Optical Character Recognition (OCR) scanning as a method of preparing machine-readable study documentation in the late 1980s. Approximately 10,000 pages of documentation were scanned per year using OCR, which was about 30 percent of the annual documentation intake. OCR scanning proved to be a laborious and time-consuming process, however, and it sometimes introduced errors. That generation of scanning technology often could not distinguish between the numeral “1” and a lower case “l”, for instance; extensive proofreading and editing were required to produce the finished product. In addition, OCR could not handle the tables and other graphical elements common to many questionnaires, and variations in print quality were problematic as well.

This early experience demonstrated that OCR technology alone would not be adequate for conversion of ICPSR’s hardcopy document holdings. As an alternative, ICPSR considered providing bit-mapped image files to users. One advantage of this method is that bit-mapping provides an exact replica of the hardcopy pages. There were disadvantages to this technology, however, in terms of storage, portability, printing, and user-friendliness. For instance, a rough calculation done in March 1993 showed that about 40 gigabytes of disk space would be needed for storage of ICPSR’s codebook collection as image files, even in compressed form. Additional disk space would be necessary for working with the files before they were compressed, and for uncompressing the files. Users also needed large amounts of space for storage of the image files at their local installations. In addition, few printers at that time were equipped to print bit-image documents.

MAY 1995 RICHARD ROCKWELL, ICPSR EXECUTIVE DIRECTOR, ESTABLISHED A COMMITTEE TO DEVELOP A DOCUMENT TYPE DEFINITION (DTD) FOR AN INTERNATIONAL CODEBOOK STANDARD USING STANDARD GENERALIZED MARKUP LANGUAGE, OR SGML. IN 1997, THE DTD, WHICH PROVIDES A SET OF RULES FOR THE MARKUP OF DOCUMENTS, WAS MADE COMPLIANT WITH XML (EXTENSIBLE MARKUP LANGUAGE), A SUBSET OF SGML THAT IS MORE SUITABLE FOR DISPLAY ON THE WEB. THIS PROJECT IS KNOWN AS THE DATA DOCUMENTATION INITIATIVE (DDI) AND IS SUPPORTED IN PART BY THE SAME NSF GRANT THAT IS CONTRIBUTING TO ICPSR’S ELECTRONIC DOCUMENT CONVERSION PROJECT, MAKING IT A COMPLEMENTARY EFFORT.

Social science codebooks marked up in XML will lend themselves to a variety of applications. Because of their structured and encoded nature, XML codebooks can be used in the production of data definition statements for SAS, SPSS, and other analysis software as well as for information discovery and retrieval. ICPSR will mark up only a portion of its electronic codebook collection, but it is hoped that as new markup tools are developed, data producers will create documentation for their studies in DDI format, making later conversion unnecessary.

The DDI project is now in the beta-test phase, which runs from March 17–August 1, 1999; thirteen test sites from around the world, chosen on the basis of proposals submitted, are currently evaluating the DTD. Testers are focusing on several different uses for the DTD and will produce reports summarizing their experiences and assessing the DTD’s effectiveness and completeness at the end of the beta period. For more information on the Data Documentation Initiative, consult the URL: http://www.icpsr.umich.edu/DDI/codebook.html.
Portable Document Format

With this experience in mind, ICPSR's newly-formed Electronic Document Conversion (EDC) unit began to explore software that employed a combination of the OCR and bit-map technologies, and in 1995 settled on Portable Document Format (PDF). This format, developed by Adobe Systems Incorporated for use with its Acrobat software, yields a document that is searchable and manageable in size but retains the page layout and the appearance of the original. PDF documents can be enhanced with indexes, thumbnail sketches, bookmarks, and links.

PDF also provides ICPSR with a uniform standard for the archiving of documentation—a standard that is rapidly growing in popularity on the Internet. Moving to the PDF standard for all ICPSR technical documentation resolves the problem of archiving and disseminating machine-readable documentation in varying formats. With electronic documentation files received in different versions of word processing packages such as Microsoft Word or WordPerfect, users often have trouble reproducing the fonts or some other portion of a document, and conversion to ASCII text often results in a loss of information. Moreover, these word-processed documents are not suitable as archival copies since their usability in the future is questionable, given the continuing upgrades to their native formats. With the substantial international commitment to PDF demonstrated by government, industry, and academia, it is likely that an effective migration strategy for PDF documents will be widely available when a superior technology emerges.

ICPSR's "Retrofit" Project

In 1997, ICPSR received a grant from the National Science Foundation to assist in the conversion of older paper documentation to PDF form and to support the development of a documentation standard for the social sciences (see sidebar). Scanning priorities were established and are continually reassessed as the project continues.

ICPSR has implemented two major methods of high-speed scanning to convert the backlog as quickly as possible. One effort makes use of the Xerox Docutech device, a high-speed copy machine used in the Duplicating Department at the Institute for Social Research (ISR). Previously, hardcopy materials were reproduced with the Docutech, but the internal image created during the copying process by the Docutech software was not usable, since it was a proprietary format. Xerox developed a solution in 1998 that successfully converts the proprietary format to a TIFF file, and with additional hardware, ISR Duplicating began storing all Docutech scans (copies) on tape. The TIFF files are easily transformed into PDF files.

In addition, a subunit of the EDC team at ICPSR was established to do nothing but scan on a constant basis, rather than scan and edit. All hardware was moved to a specific scanning area, allowing one person to operate all machines. Four scanning machines are now in operation, and the EDC unit has five permanent and two temporary employees.

ICPSR Data Library to determine if there are missing sections or pages.

For a paper document, the EDC staff determines which software is best suited for scanning a document. They may also need to perform test runs to determine the best settings to use on the scanner so the type displays legibly. The document is scanned, and the image file that is created is processed into an editable file. In some cases, stray marks or items such as handwritten notes that the processor does not want on the final document are digitally erased. The staff reviews the editable copy of the digitized document and makes corrections as required. Some documents require extensive proofreading and editing.

With machine-readable documents, EDC again determines which software is most suitable for each part of the document. Some documents are received fully formatted. Other documents have layout, pagination, or typeface problems or contain tables or other graphical elements that must be processed to display well in the final document. Some documents are submitted in older versions of popular software or in unusual software formats and require substantial reworking.

Most documents at ICPSR are processed in the PDF "image + Hidden Text" format, which creates a "snapshot" of the page but includes the recognized text behind the bit-map image. This means a page looks exactly like the original because the original image is reproduced, but the file can still be searched because the text that was recognized (through OCR) exists behind the image. By default, after a page has been scanned and converted to PDF, the software leaves as bit-map images in the PDF output file any words that it suspects may not have been recognized correctly. For many applications, this technique is the most cost-effective way of converting hardcopy documents to electronic documents. However, if error correction is desired, other software can be used to display the converted pages for editing.
After a PDF file is created, whether it was scanned from a paper original or processed from a machine-readable document, the EDC staff adds enhancements. A bookmark list is added on the left side of the file to allow easy access to the major sections of a document. By clicking on a bookmark, the user can "jump" automatically to that section of the file. Thumbnails, which are small copies of each page, are created to help users navigate a document by looking for the likeness of the page or section they are seeking. Sometimes links are created; the links enable a user to click on highlighted words on a page to access another part of the document itself, a website, or an external document.

A cover and front matter prepared by the ICPSR editors are added, and the PDF documentation is ready for a quality check before final release on the ICPSR website. A second EDC staff member quality-checks each document, clicking on every bookmark and link and checking each page to verify that no problems exist and to ensure that the document meets ICPSR standards.

**Progress to Date**

During fiscal year 1997-1998, ICPSR's EDC unit converted over 122,000 pages of documentation to PDF, an average of approximately 470 pages per working day. This total is nearly four times the amount scanned in the previous year. While most of the pages scanned that year were new documentation, progress is being made on the retrofit project also, with the documentation for approximately 360 studies converted since the project began. ICPSR hopes to have its backlog of over 500,000 hardcopy pages online by the year 2001.

Efforts continue to encourage data depositors to submit their original documentation in machine-readable form, but despite ICPSR's efforts in this area, about 54--60 percent of the documentation received by ICPSR still arrives in hardcopy form.

**Additions to Holdings**

- **ABC News Clinton Statement #2 Poll, August 1998 — ABC News (ICPSR 2633)**
- **ABC News Clinton Terrorism Poll, August 1998 — ABC News (ICPSR 2634)**
- **ABC News Clinton Videotaped Testimony Poll, September 1998 — ABC News (ICPSR 2644)**
- **ABC News Pre-Election Poll #1, October 1998 — ABC News (ICPSR 2647)**
- **ABC News Pre-Election Poll #2, October 1998 — ABC News (ICPSR 2648)**
- **ABC News Pre-Election Poll #3, October 1998 — ABC News (ICPSR 2649)**
- **ABC News Starr Report Poll #1, September 1998 — ABC News (ICPSR 2638)**
- **ABC News Two Clintons Poll, August 1998 — ABC News (ICPSR 2635)**
- **Central and Eastern Eurobarometer 8: Public Opinion and the European Union, October-December 1997 — Jacques Vantomme and Louis Hersom (ICPSR 2624)**
- **CBS News Monthly Poll #1, October 1998 — CBS News (ICPSR 2677)**
- **CBS News Monthly Poll #1, November 1998 — CBS News (ICPSR 2668)**

CBS News “60 Minutes” Poll, November 1998 — CBS News (ICPSR 2653)


Cross-National Indicators of Liberal Democracy, 1950–1990 — Kenneth A. Bollen (ICPSR 2532)

Effects of Community Policing on Tasks of Street-Level Police Officers in Ohio, 1981 and 1996 — Lawrence F. Travis III and Beth A. Sanders (ICPSR 2481)


Foreign Policy Leadership Project, 1976–1996 — Ole R. Holsti and James N. Rosenau (ICPSR 2614)


BIENNIAL MEETING OF OFFICIAL REPRESENTATIVES
October 14–17, 1999
Ann Arbor, Michigan

“Approaching the Millennium: New Paradigms for Social Science Research”

Please join us as ICPSR Official Representatives, Council members, and staff convene to discuss topics of interest to those involved in all aspects of the social science research process. An informative and thought-provoking program has been planned, with sessions covering the following topics:

- Orientation for New ORs
- Data Documentation Initiative
- Comparative Data
- Confidentiality and Disclosure
- Using ICPSR Resources for Online Analysis
- Digital Government Initiative
- Instructional Uses of ICPSR Data
- New Methodological Approaches

All sessions for the 1999 meeting will be held in the Michigan Union on the University of Michigan campus; Saturday night’s banquet dinner will take place at the Michigan League. A reception is planned for Friday night at ICPSR’s new location, 311 Maynard Street.

An online registration form, along with other information about the meeting, will be available soon on the ICPSR Website at http://www.icpsr.umich.edu.
Revisions/Updates


Higher Education General Information Survey (HEGIS), 1982: Fall Enrollment — United States Department of Education. National Center for Education Statistics (ICPSR 8292)


Public Support for Rehabilitation in Ohio, 1996 — Brandon K. Applegate (ICPSR 2543)

Social Networks and Television Manager Turnover, 1997: [United States] — Michael Davern and David S. Hachen, Jr. (ICPSR 2650)


Publication-Related Archive

Price Stability and Financial Stability: The Historical Record — Michael D. Bordo and David C. Wheelock (ICPSR 1191)

Data on Crime and Community — Sponsored by National Institute of Justice (ICPSR 2434) [CD0024]

CD-ROMs


National Longitudinal Study of the Class of 1972 — United States Department of Education. Center for Education Statistics (ICPSR 8085)

National Survey of Access to Health Care, 1986 — Howard E. Freeman (ICPSR 8981)

National Survey of Access to Medical Care, 1982 — Ronald M. Andersen and Lu Ann Aday (ICPSR 8244)

Summer Program, 1999

First Session
(June 21–July 16)

Lectures
Mathematics for Social Scientists I
Mathematics for Social Scientists II
Introduction to Computing
Advanced Topics in Social Research*

Workshops
Quantitative Historical Analysis
Introduction to Statistics and Data Analysis I
Mathematical Models: Game Theory
Introduction to Regression Analysis
Regression Analysis
Multivariate Statistical Methods
Scaling and Dimensional Analysis
Maximum Likelihood Estimation

Second Session
(July 19–August 13)

Lectures
Nonlinear Systems: Adaptive Systems
Introduction to Computing
Dynamic and Longitudinal Analysis
Matrix Algebra
Advanced Topics in Social Research*

Workshops
Simultaneous Equation Models
Regression Analysis
Time Series Analysis
Mathematical Models: Rational Choice
Introduction to Statistics and Data Analysis II
Categorical Analysis
LISREL Models: General Structural Equations
Advanced Analysis of Variance
Quantitative Analysis of Crime and Criminal Justice
Advanced Maximum Likelihood Estimation
Quantitative Methods and African Studies

One-Week Statistical Workshops

Spatial Analysis/Geographical Information Systems (August 9–13)
Multi-City Study of Urban Inequality (June 21–25)
Categorical Data Analysis I (June 7–11)
Categorical Data Analysis II (June 14–18)
Criminal Justice Data: Women and Crime (June 21–25)
Hierarchical Linear Models (July 12–16)
Mental Health Research (July 12–16)
LISREL Models: Introduction (July 26–30)
LISREL Models: Intermediate (August 2–6)
Social Network Analysis (June 28–July 2)
Providing Social Science Data Services (August 2–6)
Latent Growth Curve Analysis (May 21–23: Chapel Hill, NC)
Selection Bias in Aging Studies (June 14–18)

*Advanced Topics

Resampling Techniques: Jackknife and Bootstrap
Statistical Graphics for Univariate and Bivariate Data
Missing Data Analysis
Data Visualization and Interactive Cluster Analysis
Bayesian Modeling
Nonparametric Regression
Ecological Inference

For a copy of the 1999 ICPSR Summer Program brochure and application, contact:

ICPSR Summer Program, P.O. Box 1248, Ann Arbor, MI 48106-1248, Phone: (734) 998-9888, E-mail: sumprog@icpsr.umich.edu,
or consult the Summer Program Website at http://www.icpsr.umich.edu/sumprog/
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The Inter-university Consortium for Political and Social Research (ICPSR), located at the Institute for Social Research in Ann Arbor, is the world’s largest repository of computer-readable social science data. For over 35 years, the Consortium has served the social science community by acquiring, processing, and distributing data collections on a broad range of topics. Researchers at the Consortium’s member institutions may use any of these data collections at no charge; researchers at nonmember institutions may also use the data, after paying an access fee. To find out more about ICPSR’s holdings or to learn more about a specific data collection, access the ICPSR Website at the URL: http://www.icpsr.umich.edu.

The ICPSR Bulletin is published four times during each academic year to inform Official Representatives at the member campuses, ICPSR Council members, and other interested scholars of activities occurring at ICPSR and at other member institutions and to list the data collections most recently released or updated by ICPSR. For subscription information, contact the Editor.

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