



Project Summary

Decision Support System for Drinking Water Research Using Microcomputers and Mainframes

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The U.S. Environmental Protection Agency's (EPA) Drinking Water Research Division (DWRD) is responsible for performing research to maintain and improve the quality of drinking water. With passage of the Safe Drinking Water Act in 1974, DWRD's extramural and intramural research activities and budget significantly increased. In response to these challenges, DWRD developed a Decision Support System to manage and analyze research data.

The system uses a mainframe computer for archival purposes and for major computations. It had evolved from a relatively primitive system towards the use of a state-of-the-art IBM 3090 mainframe, with IBM PC-AT's* as intelligent terminals and as standalone computers. The system has been highly successful and has significantly enhanced DWRD's ability to support Agency policy-making functions as well as to provide polished information to the drinking water community outside of EPA.

This Project Summary was developed by EPA's Water Engineering Research Laboratory, Cincinnati, OH, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Introduction

According to the 1972 annual report of the U.S. Council on Environmental Quality, "...accurate and timely in-

formation on status and trends in the environment is necessary to shape sound public policy and to implement environmental quality programs effectively." The need has never been greater that it is now.

In 1974 with passage of the Safe Drinking Act, DWRD experienced expanded research activity and massive increases in data flow. These activities created many data analysis problems and, in response to these challenges, DWRD developed a Decision Support System (multiple decision assistance mechanisms usually based on computer technology) to manage and analyze research data; its purpose is to help managers and other users make key decisions. The development of such a system and its basic elements will be discussed in this Project Summary.

Development of Data Management Functions

In 1975, EPA began a series of field projects to assess the removal of organics from drinking water and needed to compare the data across different projects. The data arrived in highly varied formats and with errors. These difficulties, together with the sheer mass of data and the lack of a suitably sophisticated data processing methodology, provided the impetus for developing a new decision support system. The DWRD staff and the University of Michigan collaborated to develop a system for managing and analyzing these data in a way that would satisfy the needs of the research community.

The system for storage, retrieval, and analysis of drinking water data evolved

*Mention of trade names or commercial products does not constitute endorsement or recommendation for use.

over time and was governed by the availability of both hardware and software and by the willingness of personnel to be trained.

The system that was developed used a mainframe computer as a central host. Inhouse data entry and analysis were done initially through dumb terminals, and an inhouse minicomputer was used for transmission purposes. Direct data entry was then instituted to include laboratory instruments, graphics terminals, word processors, and intelligent terminals (e.g., personal computers); entry was achieved directly from extramural projects as well as from inhouse points. Data from all these sources and from existing Agency databases were merged as necessary into larger databases for easier use.

The following data bases were developed as part of the project.

- ICDATA — roughly 1000 water supplies and 45 water quality parameters organized under the database management system at the University of Michigan (MICRO) contains the data of the last update of the Interstate Carrier Program of EPA.
- ICDATA/M — roughly 2000 records on about 1000 water supplies; constructed using all available information from past EPA records.
- NORSDATA — EPA's National Organics Reconnaissance Survey (NORS).
- NOMSDATA — three phases of the National Organics Monitoring System (NOMS) of EPA's Office of Drinking Water; also contains data on trihalomethanes and such conventional parameters as CCE, TOC, and COD.
- CWSSDATA, including the Community Water Supply Study (CWSS) — drinking water quality data in the State of Vermont and in selected areas in the United States that EPA surveyed in 1969.
- DURFOR — the drinking water quality data of the 100 largest U.S. cities; exists under both MICRO and MIDAS and is based on a 1960 survey by the U.S. Geological Survey.
- THOUWATER, the so-called "1000 City Survey" — inorganic parameters of raw, finished, and distributed waters for about 600 cities.
- CARDIO/M — cardiovascular disease mortality rates by county, available under MIDAS; contains age-adjusted, 3-year-average, stan-

dardized cardiovascular disease mortality rates for both sexes.

- CANCER/M — age-adjusted, 20-year-average, cancer mortality rates for each race and sex group in a selected set of counties.

While developing these data bases, DWRD staff entered data from field and inhouse projects that were ultimately used in the Decision Support System. Typical of this approach were projects at Thornton, Colorado, and Charlotte Harbor, Florida.

Thornton Project

Drinking water for Thornton is produced by two treatment plants with a total capacity of 20 mgd. The raw water source for one plant is affected by upstream wastewater discharges to the South Platte River. The major concerns are high concentrations of ammonia, organic precursors that form trihalomethanes greater than established limits, and other potentially harmful organics.

The large amount of data gathered during the course of the project delayed its reporting and analysis. Data from notebooks compiled in Thornton were entered in Cincinnati and transmitted to EPA's National Computer Center (NCC) at Research Triangle Park, NC. Both the project manager and project personnel needed early access to the data and wanted to analyze the data jointly.

In August 1982, an Apple II+ system with floppy disk drives, plotter, printer, and communications was installed at the Thornton water treatment plant. This permitted direct entry and verification and previewing of the analyzed results. The system was later upgraded with a Tektronix graphics emulator chip to allow direct viewing of the graphs generated at EPA's NCC.

The software provided for word processing, plotting, and communications. The major need at the beginning was to enter the data directly into the NCC system. A program was written that would allow off-line data entry into the Apple, editing of these data, and subsequent submission of the data at maximum speed to NCC. Calculations and transformations of the data were done at the NCC.

Charlotte Harbor

The Charlotte Harbor Water Association (CHWA) has been conducting pilot plant studies since 1979 because of the need

(1) to develop data on reverse osmosis (RO) treatment to remove inorganic contaminants listed in the National Interim Primary Drinking Water Regulations and (2) to develop low-pressure RO membranes.

The considerable amount of data that were generated were recorded in notebooks, transcribed into quarterly reports, and sent to EPA for key-punching. The EPA project manager wanted to receive the data in a timely fashion and wanted to ensure some data quality control because the several transcription steps introduced errors at every step.

In August 1982, an Apple II micro-computer system with floppy disk drives, plotter, and communications was installed at the CHWA. The software provided for word processing, communications, spreadsheeting, and plotting. This system allowed local recording of the data in a machine-readable form and a review and preliminary analysis of the data. To transfer the data, floppy disks were exchanged, although direct phone transfer was also tested.

Evolution of the Computer System

The system has thus developed from the original University of Michigan mainframe development (using for input Apple-based systems and floppy disk drives) to the EPA NCC IBM mainframe (3090), (using as input/output devices IBM PC-AT's with fixed disks to considerably enhance standalone computing power.)

The incorporation of recent personal computer hardware and software and telecommunications provides a powerful analytical tool for (1) extramural plant personnel, (2) DWRD staff, and (3) other members of the drinking water research and regulatory community to obtain rapid and precise research results and a much better understanding of treatment plant design and performance parameters.

Conclusions

The development of the Decision Support System has led to an extensive collection of drinking water quality data on the major water supplies in the United States. Using large central computer systems with easy access over the telephone networks allowed potential users to access the data from any point in the United States. The significant amount of

training fostered "computer" literacy that will be of great use to DWRD in the future.

Using microcomputers to acquire and analyze data at several pilot plants proved quite successful. Newer data sets will be added to the existing ones to provide a long-term record of the drinking water quality in the United States.

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The complete report, entitled "Decision Support System for Drinking Water Research Using Microcomputers and Mainframes," (Order No. PB 88-114 079/AS; Cost: \$14.95, subject to change) will be available only from:

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