

D THE COLORADO EXPERIENCE (EVALUATION & SELECTION OF HARDWARE FOR  
AUTOMATED, GEO-BASED INFORMATION SYSTEMS)

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Introduction

1 General

Following two years of design and development, an automated geo-based information system has been activated in the Colorado Department of Local Affairs. Based on the contracting authority's specifications, the turnkey system was produced by Environmental Systems Research Institute, Redlands, California. It is important to note that operationally the Colorado system is not comprehensive, but dedicated to 1980 census data. Examples of design objectives in that respect include technical assistance to legislative redistricting and State Census Data Affiliate activities. The present arrangement in which the State Cartographer and State Demographer are part of the same organization and share the same geo-based information system is especially fortuitous during a census decennial year.

2 Mandates

The State Demographer and State Cartographer are presently (March, 1981) components of the Division of Planning in the Department of Local Affairs. The former is required by statute to provide estimates and projections of population while the latter is required by Executive Order of the Governor to establish standards and criteria for automated mapping and geo-based data. As a consequence, our system is generally referred to as an automated census mapping system.

System Acquisition

1 Feasibility Study

First among the many convoluted events leading to the acquisition of the Colorado automated census mapping system was a legislatively-mandated feasibility study. Due to the complexity of the task and the extremely short timeline for accomplishing it, the Division elected to have a consultant produce the study and Comarc Design Systems, Inc. of San Francisco, California was selected from among three vendors. The thrust of the study was to determine the best

way to establish standards and criteria for automated, geo-based information systems and one of the conclusions was that standardization would accrue from the establishment of a service facility which would minimize the proliferating number of dedicated systems.

## 2 System Specifications

The completed feasibility study was delivered to the Joint Budget Committee of the Colorado Legislature which responded by directing the Division to take steps to establish an automated system. Acting on that directive and based on the user needs outlined in the feasibility study, the State Cartographer set about to develop preliminary specifications for the system. These specifications were translated into a request for proposal.

## 3 Request for Proposal

Colorado procurement regulations permit, among others, three avenues for the acquisition of computerized systems; these are: (1) sole source, in which the device to be acquired can only be made available by a single vendor; (2) invitation for bids, in which the cost factor generally takes precedence over others; and (3) request for proposal, in which the cost factor is but one of several factors to be considered. The latter procedure was elected with an emphasis to be placed on the price/performance ratio of the system proposed.

The request for proposal, while designated to reflect the preliminary specifications, is more than just a simple technical document. Included is a description of the events leading to the decision to acquire the system, the present institutional arrangements affecting the system, the immediate and far-term applications, the procurement requirements of the State of Colorado and an outline of the required format of any proposal submitted in response to the request.

The request for proposal was issued through the Division of Purchasing with the advice and counsel of the Division of Automated Data Processing, both in the Department of Administration. This issue includes a requirement for a letter of intent to submit a proposal and 23 letters were received. After the expiration of the withdrawal period, six vendors had submitted eight proposals. One vendor submitted three proposals and five vendors submitted one proposal each.

4 Vendor Resolution Meeting

A vendor resolution meeting was convened after the eight firm proposals had been received. The purpose of the vendor resolution meeting was to answer all questions about the specifications and system requirements outlined in the request for proposal. Procurement regulations in Colorado require that the answers to questions raised by one vendor be made available to all vendors and the most expedient way to accomplish this was to convene all concerned vendors at one time. The State Cartographer responded to all questions both orally and in writing and copies of the written responses were transmitted to each of the six vendors.

5 Proposal Evaluation

Completion of the adjustments to the proposals on the basis of the vendor resolution meeting marked the end of the period allocated to the receipt of proposals. The next event was the evaluation of the eight acceptable proposals. Accordingly, an evaluation team was assembled and each team member assigned an evaluation element, thus:

- compliance of the proposals with format and content requirements,
- vendor's management philosophy as evidenced by the architecture of the system as proposed,
- vendor's experience as evidenced by prior systems installations in similar institutional settings,
- support delivery including warranties, maintenance, documentation and training,
- hardware configuration, and
- software characteristics.

These evaluation elements were assembled into a matrix and assigned point values for a total not exceeding 1,000. The eight proposed systems were ranked in accordance with total points awarded.

6 Price/Performance Ratio

It is important to note that up until this point, no consideration of price had been included in the evaluation. In fact, Colorado procurement regulations require that pricing information be bound separately in the proposal. When the proposals are received in the

Division of Purchasing, the pricing information is kept from the evaluators until the performance evaluation has been completed. At this point, the pricing information is introduced and a price/performance ratio is developed. On the basis of this ratio, three of the eight proposed systems were selected.

## 7 Benchmark Tests

A uniform benchmark test was designed in order to rigorously test the three final systems. Since the system was designed as an automated mapping system for use with decennial census data, the test data included the following:

- 1970 census map of Pueblo, Colorado produced on transparent scale-stable material at 1:24,000 scale.
- 1970 topographic map of Pueblo, Colorado produced on transparent scale-stable material at 1:24,000 scale.
- 1970 census data for Pueblo, Colorado on computer-compatible magnetic tape.
- a macro-flowchart of the test procedures to be used which included tasks in three categories (statistical, cartographic and statistical/cartographic merge). The flowchart also included the minimum number of iterations required for each task.

Each of the three vendors was sent a benchmark test package including all of the above data and an on-site test was scheduled. Two-day tests were conducted at each facility. At the conclusion of these tests, the results were summarized and a system accepted from among the three finalists. A notice of intent to buy was sent to the finalist and contract negotiations were initiated.

## 8 Performance Test

A distinction must be drawn between the previously described benchmark test and the performance test to be described. The former is conducted under controlled circumstances at the vendor's facility. The latter is conducted under uncontrolled circumstances at the contracting authority's facility. Colorado procurement regulations require a 30-day period of performance testing at the end of which the system, if satisfactory, will be accepted. Briefly stated, the benchmark is a pre-installation test, while the performance is a post-installation test. With the completion of the performance test, acceptance of the system and award of contract, the procurement cycle had been completed.

## System Architecture

The automated census mapping system is a turnkey system driven by software developed by the Environmental Systems Research Institute and includes the following hardware components:

- central processor — a PRIME 250 minicomputer with 512K memory. The processor includes one dial-up port and an RJE interface with the State of Colorado Sperry Univac 1100/82 for additional flexibility.
- tape drive and disk storage — an integral tape drive and 96MB disk drive.
- digitizing station — one TALOS 848B digitizer having a 36 x 48-inch backlighted surface with 16-button, 4X magnification cursor and .001-inch resolution.
- plotter — Houston Instruments CPS-15 drum plotter having four color pens, 34.5-inch plotting width and 12.7-inch per second diagonal plotting speed.
- graphics terminal — one Princeton 8500M intelligent graphics terminal having 4096 x 3072 programmable density points and full range of gray scales; black-and-white raster scanning admits interactive editing and vector generation.
- line printer — one PRIMENET line printer with 300 lines per minute print rate.
- work stations — four Hazeltine 1510 CRTs.

The access ports are now fully occupied and we plan to add one additional eight-port communications board and one 256K memory board.

## System Applications

At present, the State of Colorado Automated Census Mapping System is dedicated to the management and mapping of 1980 census data in order to provide support for the State Census Data Center and assistance to the legislative redistricting and reapportionment process. In addition, a State/Local Government geo-based information pilot project has been initiated. The purpose of the pilot project is to determine the problems to be encountered when applying a State system to local projects. Participants in the pilot project include the R-1 School District, Planning Department, Automated Data Processing Department and Mapping Division, all of Jefferson County, Colorado.

The following projects are in the design stage and will be integrated with the system as soon as feasibility has been demonstrated and present operational requirements have been met:

- in concert with the U.S. Geological Survey, the utilization of digital elevation model and digital terrain model tapes.
- in concert with the U.S. Board on Geographic Names, the utilization of geographic names information system tapes.
- in concert with the NASA Ames Research Center, utilization of Landsat imagery and digital data.
- in concert with the OMB/Colorado A-95 review process, the automated tracking and mapping of grant awards and funding allocations.

It is generally recognized that the integration of these large databases will require additional central processor capacity and the application of a true database management system.

#### Summary

A brief recapitulation of the preceding information will show that the evaluation and selection events can be sequentially arranged in the following categories: (1) design and development; (2) feasibility studies and preparation of specifications; (3) request for proposal and evaluation of responses thereto; and (4) testing and installation. Having described this sequence of events, albeit briefly, I am compelled to offer the following counsel: (1) the turnkey system which permits one-stop troubleshooting seems generally preferable; (2) the acquisition of a system that includes source codes seems preferable to one that does not, thereby facilitating in-house modification of routines; (3) every reasonable effort should be made to acquire a system that includes a database management subsystem; and (4) the procurement procedure should include a constraint on the cost of future upgrade. The latter should be expressed as a percentage of the cost of the initial system; however, in fairness to the vendor and in consideration of the inflation rate and resultant discount value of the dollar, this constraint should be limited to a mutually agreed upon period of time.