

many articles for *TRNews* or for formal presentation at the Annual Meeting, and/or through nomination of a small number of outstanding papers to be reprinted in the Transportation Research Record series.

ACTION 11. Staff should explore ways in which information about the Annual Meeting program can be made available earlier than by normal delivery of the November-December issue of *TRNews*.

TRB found a way to get the 1983 Annual Meeting tentative program (November-December *TRNews*) to other countries much earlier than ever before. As a by-product, TRB has also resolved to improve delivery of the tentative program to domestic as well as overseas locations. Beginning this year, the tentative program will be separated from the *News*, permitting an earlier mailing date and an overall cost saving. (See related story, page 29.)

ACTION 12. In future appointments to the Executive Committee, consideration should be given to individuals who would bring a perspective on transportation from the viewpoint of other countries and/or of international trade.

COMMENT

TRB's International Coordinator and the new Committee on International Activities will be working hard to carry out the Action Plan approved by the Executive Committee. But if theirs is the only effort, we will not move very far toward answering the questions posed at the beginning of this article. To provide benefits to the Board, to its constituents, and to transportation both here and abroad, the combined efforts of many will be required. To this end, readers are encouraged to offer suggestions and assistance, and, above all, to participate in these actions in every possible way.

Bid Analysis and Management System

Kansas Department of Transportation "BAMS" Away at Bid-Rigging

KENNETH STODGELL

U.S. News & World Report (February 16, 1981) published an article titled "Highway Robbery: The War on Bid Riggers" that maintained, "Crooked highway and paving contractors have been socking the public with overcharges running into millions upon millions of dollars." The subject of that article, of course, was "bid-rigging." Collusion on state contracts and bid-rigging is known to be widespread. It infringes on the highway contracting process in many states, including Kansas.

Due to collusive activity in the construction industry, the Kansas Department of Transportation (KDOT) recognized the need for a bid monitoring system. After an in-house evaluation and meetings with consultants from Info-Tech, Inc., of Gainesville, Florida, it was determined that Info-Tech's Bid Analysis Monitoring System (BAMS) met the agency's overall objectives for a bid analysis tool. KDOT was the first organization in the country to complete the BAMS installation process; the system went on line in February 1983. KDOT's Construction and Maintenance Bureau and Office of the Inspector General are using BAMS in the areas of contract cost estimation, bid analysis, and bid investigations. The tools to develop and maintain a complete historical data base, a set of application/analysis programs, and a menu-oriented user interface are provided to assist KDOT personnel in a user-friendly environment. KDOT per-

sonnel have found the system to be flexible enough to allow easy ad hoc reporting from the historical base, which includes color-graphic capabilities as an integral part of the system. BAMS was installed with a minimal impact on existing systems and few support requirements from data-processing personnel. The system interfaces with existing bid data files

Feature

and collects information that spans the entire contracting process—pre-letting, letting, and post-letting.

This article reviews (a) the status of legal proceedings and actions in Kansas concerning bid-rigging and (b) the available and proposed preventive measures instituted by the Kansas state government that may be of assistance to other states.

HISTORIC BID-RIGGING ACTIVITY

Bid-rigging has been defined as the concerted activity of two or more qualified bidders to determine, by private agreement,

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Preparing to input data related to BAMS are (L-R) Daniel Watkins, Special Assistant to the Secretary, KDOT; John B. Kemp, Secretary of KDOT; and Kenneth Stodgell, Management Analyst, Office of the Inspector General, KDOT.

the winning bidder of a public contract let for competitive bidding. One should not, however, get the impression from the recent explosion of bid-rigging publicity and actions that such activities are of recent origin. They are not. Price fixing is not a recent phenomenon anywhere. In Kansas, for example, a case dealing with fixing the price of grain reached the Kansas Supreme Court under the state's antitrust law in 1902.

The basis for recent concern and alarm arises not from the "newness" of bid-rigging but from the large amounts of money involved and the recent discoveries that a significant number of highway construction contracts let by KDOT were awarded to contractors who secured the contracts by conspiring to rig the bids. In the 1970s, the federal government began investigating and prosecuting highway construction contractors. The federal crackdown first began in Illinois and then in Virginia. Prosecutions spread into other states, including Georgia, North Carolina, South Carolina, Texas, Louisiana, Mississippi, Arkansas, Florida, Kansas, Nebraska, and Oklahoma. Many states have made notable recoveries from contractors amounting to tens of millions of dollars, with other states now following the lead of North Carolina, Virginia, and Tennessee in this area.

FEDERAL INVESTIGATIONS IN KANSAS

In late 1980, the U.S. Department of Justice initiated investigations into bid-rigging of Kansas highway contracts. A federal grand jury was convened and a probe was initiated into activities of certain contractors. On April 22, 1981, the grand jury indicted the first Kansas highway contractor, who was subsequently found guilty at trial of one count of conspiracy to rig bids and of five counts of mail fraud.

The federal law provides for a five-year statute of limitations for collusive activity and the U.S. Attorney pursued

cases of bid-rigging in Kansas from late 1976 through 1981. Of course, not all projects in Kansas during this period were "set up." It does appear, however, that as many as 10 percent of the contracts may have been procured by contractors through the use of collusive methods. In this five-year period, KDOT had let 2,665 contracts amounting to more than \$815 million. At this time, it appears that the dollar amount of contracts that involved collusive bidding ranges up to a total of about \$50 million. To date, 14 companies and 17 individuals have been indicted and convicted on projects where contracts total \$12,911,251.61. The indictments do not name every project that was rigged, but only those projects on which the U.S. Attorney sought a conviction.

In Kansas, after the first conviction at trial, in a domino-like fashion, upon the filing of indictments or an information, highway contractors would plead guilty in return for settlement of their cases without trial. After the first trial and conviction, 13 guilty pleas involving corporations and 15 of their respective presidents and officers were entered. Two additional trials involving one other company and two of its officers have resulted in hung juries. The convictions and all guilty pleas were to felony charges.

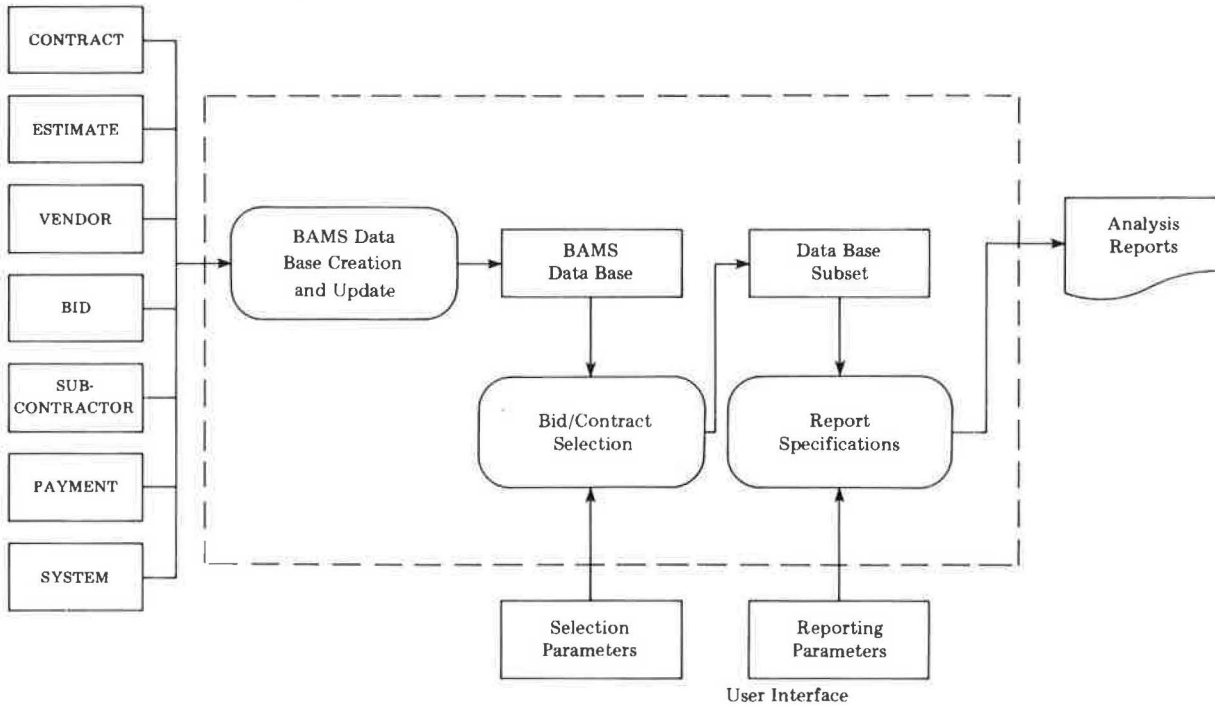
MONITORING SYSTEM SELECTED: BAMS

In light of this activity, KDOT officials began to develop procedures to monitor the bidding process. KDOT personnel attended AASHTO meetings in New Orleans, Louisiana, in April 1982 and the Florida Attorney-General's Meetings in Orlando, in May 1982. The general consensus by all concerned parties in Kansas was that the Bid Analysis Management System developed by Info-Tech, Inc., could provide an immediate source of assistance by taking KDOT's historical data base and providing sophisticated analytical capabilities to evaluate the data. In June 1982, Thomas Rothrock and William Ingram from Info-Tech were invited to KDOT to make a presentation to senior management.

This presentation emphasized the fact that BAMS is a user-oriented, full decision-support computer system designed specifically for the management, analysis, and monitoring of bidding data pertaining to the highway construction industry. BAMS collects, maintains, and produces reports including all of the data elements suggested in the guidelines for the monitoring of highway construction bidding activity established by the Federal Highway Administration (FHWA) and the U.S. Department of Transportation's Office of the Inspector General.

KDOT had been manually analyzing the bids on projects where collusion was suspected. A pattern had emerged that allowed investigators to pursue selected projects, but it was the consensus at KDOT that faster and more powerful analytic tools were needed to discover more subtle patterns. It was also agreed that BAMS could provide significant assistance in producing faster, more accurate estimates and other management information reports that could not be manually produced because of time and manpower constraints. KDOT wanted to look back to thoroughly uncover past bid-rigging practices and assist the Kansas Attorney-General in that effort—as well as look ahead to preventing such activity in the future. In addition to installing BAMS, KDOT made exten-

Figure 1. BAMS data flow chart.



sive changes in its internal policies and agency specifications to safeguard the bidding process.

CUSTOM INSTALLATION PROCESS

In August 1982, KDOT began the installation of BAMS. A unique feature of BAMS is that of being a "custom" decision-support system, one that is installed with a minimum impact on existing systems and minimal support requirements from data-processing personnel. Several on-site visits by Info-Tech personnel were required to interface BAMS with existing KDOT bid data files and to add data elements spanning the entire contracting process, which had not been maintained previously.

KDOT played an active role during the installation process. KDOT personnel provided Info-Tech with detailed information on data maintained within existing KDOT bid data files, assisted in a review of the data elements to be added, and furnished test data for debugging purposes. All technical work, including writing and implementing interface programs, was performed by Info-Tech.

During the week of January 10, 1983, final installation and user training took place. Info-Tech made several presentations and conducted training sessions on the use of BAMS through its menu-oriented user interface. In January 1983, KDOT became the first state organization to complete the installation process of BAMS. Other states that have purchased, installed, or are planning to install BAMS include Kentucky, New Mexico, Florida, Texas, and Pennsylvania.

LOADING THE HISTORICAL DATA

Before the monitoring features of BAMS could be implemented, KDOT needed to load the historical bid data it had

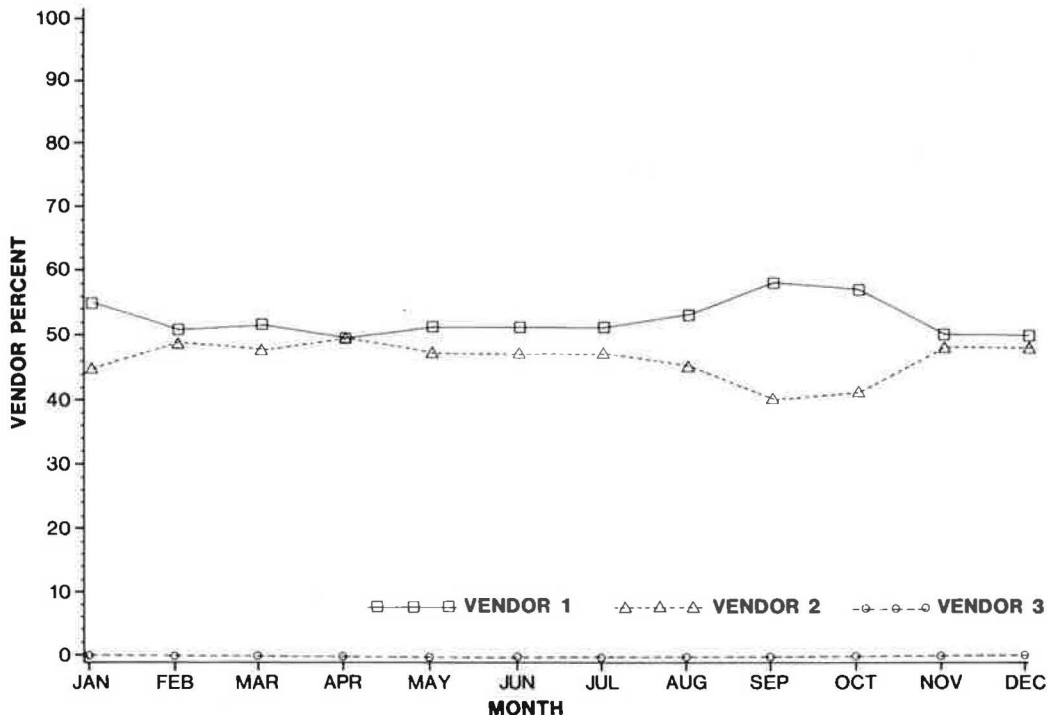
collected into the BAMS data base. This involved the following types of information: (a) contract data, (b) estimates, (c) vendor lists, (d) bids, (e) subcontracting data, (f) payment data, and (g) system data (see Figure 1).

Figure 1 also shows how the BAMS data base is integrated with three program modules that comprise the main body of BAMS. The first module represents the data management component of BAMS and consists of a set of programs used to construct, update, modify, and make error corrections to the BAMS data base. Using the menu-driven selection process, KDOT keypunchers enter data and submit data entry and data maintenance jobs. The job output provides a complete audit trail from KDOT raw data input records to the BAMS data base, showing any adjustments, modifications, and corrections in constructing the data base.

APPLICATIONS AND ANALYSIS

The selection module (module 2) and report module (module 3) represent the application/analysis components of BAMS. To generate meaningful reports and analyses from the historical data base, the system requires KDOT users to first specify selection criteria to identify a set of contracts to be analyzed. The current set of selection criteria at KDOT includes all combinations of (a) contract numbers, (b) time periods, (c) DOT districts, (d) counties, (e) vendor names, and (f) vendor status with regard to contract (won, lost, or subcontracted). For example, all contracts for a particular letting could be selected by simply specifying the letting date through an interactive dialog manager. This information could then be used to generate contract profiles or some other selected report for the subset of contracts. Output of the contract selection process consists of a report summarizing contract frequency with respect to each selection criterion and an output data set to be used by the analysis module (module 3).

Figure 2. Dynamic market share analysis, 1979, District B.



Analysis reports are produced through the BAMS interactive report program generator. A number of standard analysis reports are stored in the BAMS report program library, each with several options, thus providing a solid foundation for the varied requirements of bid management and monitoring at KDOT. Reports currently available for KDOT use are

1. Contract Profiles—Summarize contract specific information including description, dates, bidders, and subcontractors;
2. Line Item Profiles—Display item bids graphically and numerically;
3. Contract Award Maps—Generate two- or three-dimensional maps displaying contract award amounts by district or county;
4. Vendor Competition Matrices—Display number of times vendors bid and win against each other;
5. Market Shares—Display vendor market shares by month and for the entire time period under consideration; and
6. Vendor Activity Maps—Plot project coordinates color-coded to winning vendors; also plot projects associated with a particular vendor color-coded by the vendor's status (win, loss, or subcontract).

A dialog is conducted with the KDOT user that results in the selection of specific reports to be generated from the set of contract information provided by the selection module. KDOT personnel have found the report generator to be a very powerful tool, capable of producing sophisticated, tailored reports by simply entering information on the menu screens generated by the BAMS interactive dialog manager.

REPORT TYPES AVAILABLE

Several of KDOT's most requested reports are described here, including some examples of their output.

Several different market analysis reports are available. One set of reports provides KDOT with vendor market shares for selected vendors, time periods, and geographic regions. "Gross" market shares are calculated by computing the percentage of the total dollar amount over the selected subset of contracts controlled by each vendor; all work over the selected time period is accumulated before the market shares are calculated so that shares represent cumulative percentages. Tables and county maps are produced to show the geographic spread of each vendor's activity. Alternately, "dynamic" market shares are computed as the percentage of the work-in-progress dollar amount as each contract is awarded or completed; market shares are recomputed with each contract award or contract completion.

The work-in-progress percentage is plotted over months for each vendor in order to examine a vendor's activity over a selected period of time (see Figure 2). KDOT has found market share reports to be extremely useful measures of vendor activity. Gross market shares have enabled KDOT to define geographic market areas, which often do not respect district or county boundaries. Dynamic market shares have helped KDOT identify the degree of stability of vendor market shares and determine vendor capacity.

A summary of each vendor's bidding and winning activity, in total and against each of the other vendors, is provided in a vendor competition report. Output is in either graphic or tabular form. The report identifies groups of vendors competing most frequently, reveals the level of each

vendor's bidding and winning activity, and helps KDOT identify potential complimentary bidding patterns.

KDOT has made use of several other types of geographic activity maps. District maps display the total dollar value of contracts awarded in a defined geographic region (counties or districts). Asphalt plant and project location maps display selected information at asphalt plant or project coordinate points (e.g., contract delivery points, vendor supply points, and plant or warehouse locations). These enable KDOT to easily identify potential geographic market allocation schemes.

Pertinent contract and bid information is provided in two BAMS reports, the contract profiles and line item profiles. Contract profiles are a series of one-page listings summarizing important contract information (e.g., project locations, bidders' list, all "bottom line" bids). KDOT has used contract profiles when designing future contract specifications, forecasting contract budgets, and negotiating with contractors. Line item profiles (see Figure 3) compare winning and losing bids across all items on a contract or across the same item on different contracts in graphic form. Line item profiles enable KDOT to easily identify items on which "loading" or "unbalanced bidding" has occurred, analyze the degree of consistency of bidding patterns across contracts, spot discrepancies between bids and the engineer's estimate, and identify which items caused the contract to be won or lost by a particular bidder.

Several reports that use inferential techniques to evaluate contract costs are vital to the KDOT bid monitoring system.

Statistical models are used to analyze trends in the deviation between the engineer's contract estimate and the award amount, providing KDOT with a list of factors most affecting the relationship. BAMS also includes a line item price estimation system and comparative analysis over contracts. Relationships between item prices and important factors like quantity, location, contract size, and time are modeled and used to analyze the trend in item prices. The trends revealed by the cost evaluation analysis enable KDOT to provide precise cost estimates and reliable future cost forecasts.

SUMMARY

Selective bid-rigging for many years has been part of a "way of life" for some contractors and has occurred on a number of state highway projects in Kansas. KDOT officials are cognizant of the fact that BAMS cannot stop bid-rigging activities where contractors wish to engage in this practice. However, it will allow KDOT to manage its data more efficiently and analyze any patterns that warrant investigation. These new capabilities also provide the State Attorney-General with a data base that is used by attorneys to help calculate damages in past rigged contracts and provides an information base to help FHWA monitor activities of KDOT and selected contractors. Also KDOT now has a data base capable of providing significant assistance in the estimating process and of generating information for management review that was previously too difficult and time-consuming to manually retrieve and analyze.

Figure 3. Sample of line item profile, engineer's estimate.

