MECHANIZED VOTE RECORDING: A SURVEY

Prepared by

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FOREWORD

Numerous bills have been introduced in recent years that would have provided for the implementation of a system of electronic voting in Kentucky. Since the early 1960's Kentucky has required the use of lever voting machines in all elections. At the 1974 Session of the General Assembly, the Senate adopted Senate Resolution 74, directing the Legislative Research Commission and its staff to study electronic voting systems and to present findings prior to the 1976 General Assembly. This report represents the completion of that survey.

This report provides background material on the electronic voting systems and the other two mechanical methods of casting and counting votes, lever voting machines and optical scan systems. The material gathered by our staff is primarily informational in nature, and makes no recommendation as to the feasibility of implementing a new voting system in Kentucky. For the most part, a basic comparison is made with reference to the three types of voting systems.

Miss Martha Moloney of our staff has undertaken this survey and prepared the final report. Credit should be given to Mrs. Kathy Ragland for typing the manuscript for publication.

PHILIP W. CONN
Director

The Capitol
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Chapter I

Overview

Election law has undergone drastic change during the past ten years. The constitutional amendment granting 18 year old citizens the right to vote, the liberalization of residency requirements by the Supreme Court, and the provisions of the Voting Rights Act Amendments of 1970 have enfranchised millions of voters in the United States. The increased complexity of the ballot, the frequency of the elections and the millions of new voters has required election officials to look for better methods to conduct elections.

One of the more crucial and expensive decisions made by state and local election officials is the purchase of vote counting equipment. Unfortunately, many of the decisions to purchase vote counting equipment are based on either incomplete or insufficient data. In most jurisdictions,decisions are based on information supplied by manufacture of the vote counting equipment. Election officials have neither the time, staff, nor the expertise to conduct extensive evaluations to ascertain the most efficient method of vote counting for their jurisdictions. Technical experience is not often available to local jurisdictions to help select and implement new election programs. Therefore, numerous election day fiascos, well covered by the press, have occurred when newly purchased vote counting equipment has failed to produce an accurate and honest election tally.

Historical Background

Paper ballots did not come into use until 1800. During early colonial times the vote was recorded by the use of balls, coins, bullets, and beans. The first

paper ballots were usually supplied by the political parties. Each party used a different, distinguishable color for the ballot, and the voter held the ballot high so the color of the ballot could be seen. This was the beginning of "straight arm voting". During this period Kentucky conducted elections by voice vote and did not abandon the practice until after the Civil War.[1]

The Australian Ballot was declared mandatory in 1877. This was the first standard ballot which contained the names of all candidates on a single sheet of paper which was printed by a standard authority.

The first patent for a mechanical voting device was issued to Thomas A. Edison in 1869. This device was never used but broke ground for the development of a voting machine for public elections developed by Jacob H. Myers. The machine was first used in 1892 in Lockport, New York. The voting machine, a mechanical Australian ballot, grew out of the need to lessen the chance of human error and dishonesty such as chain ballots and ballot tampering which were prevalent with the use of paper ballots around the turn of the century.

In 1964 the computer entered the election process. As early as 1960, a punch card system was being used in Ohio. Martin A. Coyle was the first to develop and market a device to count votes with the use of a computer. In an attenpt to modernize the election process, electronic voting systems were developed. The term, "electronic voting system", is confusing; actually the system employs the use of the data processing punch card in such a manner that it may be tabulated by a computer. There can be no doubt that electronic voting is feasible and has worked in several states.

The optical scan system was also developed in the early 1960's and uses a ballot identical to the paper ballot, but the voter uses a fluorescent ink to mark his selections. The ballot is then read by optical scanning equipment and tabulated with the use of a computer.

Certification Procedures

Lever voting machines are the only mechanical voting devices allowed by statute in the Commonwealth of Kentucky. A constitutional amendment was passed in 1941 to allow use of lever voting machines; the 1891 constitution allowed only the use of paper ballots. KRS 117.125 enumerates the specifications and features required for approval by the county fiscal courts. Enabling legislation must be passed by the General Assembly to allow any other mechanical voting device to be used in the state. Numerous efforts to allow the use of electronic voting devices have been introduced in the General Assembly.

General Findings

There are four basic types of vote counting equipment currently available:

1. Paper Ballots;
2. Optically Read Paper Ballots;
3. Computer Punch Cards; and
4. Lever Voting Machines.

Presently, no system of vote counting equipment is superior in all areas.[2] Each system has strong and weak points. None of the systems has been found to provide all the solutions for all the election conditions encountered. A complete review of each of the mechanical vote counting devices is in Chapter 2 of this report.

The desirability of one voting method over another depends on many factors.

The precise accuracy of an election total is the most important consideration. Many elections have proven that any election can be decided by one vote. The vote counting system must guarantee the sancitity of each vote, for the production of inaccurate vote totals affects all citizens. The public must have confidence in the accuracy and the honesty of the election total.

Decisions about which type of vote counting device will be utilized should not be based on cost alone. Some factors to be considered are:

1. accuracy of the tally;
2. integrity of the election;
3. protection from overvoting;
4. rapidity of reporting the tally;
5. secrecy;
6. safeguard against fraud;
7. ease of voting method for the voter; and
8. confidence in the system.

Exact procedures of another county or an experimental election should not be totally relied upon by election officials in making an evaluation of a vote counting system. Each situation and each jurisdiction is unique in the following areas:

1. size of jurisdiction;
2. voter turnout (equipment must be purchased to meet peak demand which is usually the presidential election);
3. size of precincts;
4. complexity of the ballot (some states require ballot rotation);
5. different election laws;
6. minimum requirements for personnel and equipment; and
7. different political climate.

Paper ballots are still in use in some jurisdictions. They have proved to be accurate and reliable. The major disadvantages are the number of people

necessary to conduct the election, their salaries, and the slow method of hand tallying. Paper ballots in large jurisdictions can be more expensive to use than one of the mechanical vote counting devices.

Lever voting machines are generally acknowledged as providing the fastest and most efficient method of voting but require much preparation prior to election day. They have been employed with a minimum of operating difficulty in jurisdictions of all sizes for over forty years. In 1974, 86% of the mechanical voting systems users used lever voting machines, 13% used a punch card system, and 1% used an optical scan system.[3] Eight states mandate the use of voting machines in every precinct.[4]

Election Organization

Success or failure of the conduct of elections is directly related to the organization, planning and training of staff at all levels necessary to conduct the election. In most of the election difficulties in recent years, the fault did not lie with the system. The difficulties occurred due to people problems rather than mechanical or technical problems.

Fraud is usually a problem related to people, not systems. Automated devices lessen the chances for fraud but the election is only as honest as the officials conducting it.

Organization, planning and training of staff is essential due to the myriad of election activities. Hundreds of small but separate tasks must be performed correctly and in sequence in order to conduct a trouble-free election. Usually, the procedures for conducting these tasks are not adequately spelled out by statute or regulation. Other problems relate to the failure to fix individual responsibilities and to naming inexperienced or unqualified persons to positions of responsibility.

Some difficulties also stem from the unbelievably long and complex election codes that create confusion, rather than statutory direction. These detailed, and often contradictory, codes can actually impair the election process, for officials are prevented from using administrative discretion in dealing with the many circumstances in a complex election.

Training of poll staff at the local level is the key to effective elections. Well-trained poll workers are essential to administrating a smooth election. In a study conducted by the Office of Federal Elections it was clearly shown that poll worker training is specifically identified as the major problem facing jurisdictions.[5] It is difficult to find willing and capable, part-time election workers, who are trained and will perform effectively over a long day, in horrible conditions, for very little pay. During the November 2, 1971 election in Hamilton County, Ohio problems were encountered which were directly related to the lack of training and the situation at the counting center, where tired workers were doing a complicated and detailed task after a long day at the polls.

Jurisdictions using a voting method tied to a computer experience even more staffing, education, and training problems. Training is essential for voters, precinct workers and computer technicians. Both the precinct workers and the computer technicians handle the ballots before tallying. Fraud is usually a problem related to people, not systems. Automated devices lessen the chances for fraud, but the election is only as honest as the officials conducting it. Many difficulties occurred when changes were imposed on an existing election system or procedure. It is especially important to educate the voters when a change in voting methods is introduced, whether it is a new system of voting or a new and, in most situations, complex

ballot format. Voter education programs can be very costly. The magnitude of voter education is difficult to assess, but most vendors supply information kits and system mock-up devices.

The chance for fraud is much greater in jurisdictions employing an electronic voting system. Most critics of the system argue that a handful of people can control the results of an election, and a computer programmer bent on fraud could use a variety of devices to achieve his ends. No matter how carefully planned and tested, the chances of a program being inadequate are likely. Highly skilled computer technicians must be on hand at the counting center and they must be trained to deal with the methods of vote counting. Presently, there are very few individuals, other than the computer programmers that work with the distributors of the vote counting equipment, that have had election experience with electronic voting systems.

Breakdown problems encountered in jurisdictions using lever voting machines are usually stemmed directly from human failures. The machines do exactly as programmed to do. Staff training must include adequate preparation time for proper testing and certification procedures. Many of the problems arise during the preparation period due to the failure to assign individual responsibilities.

Chapter II

Description of the Voting Systems

The paper ballot is now considered inadequate due to the sheer magnitude of manually tabulating the results, the considerable number of spoiled and invalid ballots and the vulnerability to fraud and malpractice. Paper ballots are still used within 53% of the jurisdictions in the United States.[1] This chapter will only be concerned with the three mechanical vote counting systems.

Lever Machine Voting Systems

Basically, each voting machine is a complete polling booth surrounded by curtains to insure the voter's privacy. The voter steps into the booth, pulls the lever to shut the curtains, and votes by pressing down counting levers for the candidates and subjects of his choice. The vote is recorded automactically when the lever is again pulled to open the curtains. The vote is recorded on counters located at the rear of the machine, which is not opened until the polling place has closed. The ballot is completely secret as no paper ballots are used. Mechanical interlocks and other safeguards prevent loss of votes by over-voting and spoiled ballots.

The AVM Corporation (Automatic) and the Shoup Voting Machine Corporation are the two manufacturers that supply lever voting machines. Seismograph Service Corporation developed a lever machine in the late 1930's. This system was manufactured until 1967. Since 1967, Seismograph manufactures and distributes a punch card system. The Automatic machine is the oldest basic design still in use; Shoup machines have been manufactured since 1930.

The Automatic ballot arrangement is horizontal with the candidates arranged in party rows beneath the title of the office. Propositions are carried across the machine above the candidate section. Write-in vote slots are at the top of the machine. An example of an Automatic machine ballot face is shown in Exhibit A.

The Automatic is activated for each voter by an election officer at the machine. Selections are made as the voter pulls straight party levers or turning pointers for an individual candidate or question. As the voter makes his selection an "X" appears immediately above the name of the candidate or question selected. The vote is recorded when the voter pulls the lever to open the curtains and the "X" marks are automatically removed.

The votes are registered on counters located in the rear of the machine. The rear of the machine can be opened after the polls close and the totals are transcribed to tally sheets by matching code numbers representing each candidate and question. A printer option is available from AVM which embosses the totals directly from the counters to return sheets.

The printer options produce from three to five copies which also indicate the readings on counter dials immediately prior to the opening of the polls. This eliminates any possibility of error due to improper machine preparation.

The standard Automatic is mechanical in operation. An electrically powered machine is now available.

The Shoup ballot arrangement is in party columns beside the office titles. Propositions are carried down the right edge of the ballot face. Slots for write-in

voting are provided along the left edge beside the title of each office. An example of a Shoup ballot face is shown in Exhibit B.

An election official activates the machine for each voter by pulling a latch on the machine. An optional registration verifier is also available from Shoup using a plastic-laminated registration card given to each voter. The voter inserts the card in the machine to activate the machine for voting.

Selections are made by turning straight party or individual levers. An "X" appears by the candidate or question as selections are made.

Votes are registered on counters immediately behind the face of the ballot. After the polls close, election officials raise the steel shutters and expose the totals immediately below the names of the candidates and questions. The results are transcribed to tally sheets. The face of the machine with totals exposed may also be photgraphed to record the results.

The standard Shoup machine is electrically powered. It can also be operated manually during a power failure. A manual operated machine is also available from Shoup.

In both systems paper ballots must be supplied in case of machine breakdown. These paper ballots are also used for absentee voting, which in most jurisdictions, are counted manually.

After the polls close and the counting procedure accomplished, a copy of the precinct totals is brought to a central location where the results are compiled. Totals can be first telephoned in to expedite the count and the tally sheets delivered later.

Each lever type voting machine weighs about 700 pounds. New machines cost between $1,800 and $2,200 each, depending on the extra features. One machine will service around 600 voters. AVM machines are used in forty-two states, and Shoup machines are used in thirty-eight states. The lever type machine is the most widely used method of vote counting systems in the United States today.[2]

Some general statements can be made concerning the advantages and disadvantages of the lever voting machine.

Advantages of the Lever Voting Machine

(1) Lever voting machines provide accurate automatic tabulation of votes. (Nationwide information indicates that invariably the first returns come from jurisdictions using lever voting machines.)

(2) Lever voting machines are a self-contained unit and do not require ancillary equipment.

(3) There is little need for voter education.

(4) Voters are able to change their minds or correct mistakes without spoiling a ballot.

(4) There is a reduction in the number of precinct workers and counting center workers with the use of a lever machine.

(6) The average life of a lever voting machine is 30 to 40 years.

(7) Human errors and frauds connected with the paper ballot are eliminated with the elimination of the ballot itself.

(8) No paper ballot is used that is capable of subsequent identification with the voter.

(9) Each machine has a special lock that prevents overvoting and voiding of ballots.

(10) Lever voting machines permit consolidation of precincts which reduces the cost of the election personnel, supplies, and printing costs.

Disadvantages of the Lever Voting Machine

(1) Lever voting machines have a high initial capital investment.

(2) There are high transportation and warehousing costs with lever machines due to the considerable weight and dimensions.

Punch Card Voting System

The punch card voting system was first used in a 1964 election in Fulton and DeKalb Counties in Georgia. IBM purchased the patent rights from the inventor, Joseph P. Harris, in 1965 and then marketed the IBM Votomatic. The first punch card voting system was developed by Martin A. Coyle and was used experimentally in some localities in Ohio as early as 1960. The system developed by Coyle is no longer being used.

IBM withdrew from the voting system business in 1969. Since that time IBM has licensed five other companies to manufacture the Votomatic device covered by the patent. The companies are: CES (Computer Election Systems), Datamedia, VIP (Voting Instrument Products), EMI (Electro Mechanical, Incorporated), and Seiscor (Seismograph Corporation).

Each of these corporations has marketed the Votomatic system to different degrees. In 1972, IBM released the patents to a Votomatic trust. The Trust in turn sold the patent rights to CES. Two of the companies, Datamedia and VIP, lost their rights to market the Votomatic system because they had de-

faulted on the original license agreement.[3]

The only two companies retaining the right to sell the Votomatic system under the original patent are EMI and Seiscor. Seiscor has not actively marketed the system for several years but has been involved in research of voting systems. EMI was recently acquired by Fidlar and Chambers and is manufacturing and marketing the system.

The Graphic Arts Division of Diamond International Corporation and Carlisle-Graphics, a division of Litton Industries, developed similar punch card systems in 1970. These systems, Datavote and Accuvote, differ from the Votomatic system in that the ballot is printed on the punch card and is not prescored.

Basically, the punch card system is quite simple. The voter makes his selections by punching holes in a standard 80 column data processing card. The punched card is tabulated by a computer.

The punch card voting system includes five devices: vote recorders used by the voters in the precincts; ballot pages which are attached to the vote recorders; punch card ballots; computer programs; and the computer.

The vote recorder is a voting station that is portable and easy to store. Several may be used at each precinct. The CES vote recorder weighs about five pounds and measures 16x13x2 inches.

The ballot is mounted on the vote recorder over a mask, The mask is scored so that voters will punch holes in spaces for valid choices only. There is a slot with directional pens so the voter will insert his punch card so that it is properly positioned for voting. Each recorder has a stylus attached for punching. The chad, the paper that is punched, is forced between two strips into a box as

the voter punches a hole in his ballot. The ballot is pre-scored so that reasonable pressure with the stylus will result is a clean hole with no hanging chad.

Each voter is given a ballot card and ballot envelope. There are spaces on the inside flaps of the envelopes for the voter to record any write-in selections. An example of the ballot is shown in Exhibit C.

The voter takes his ballot to a vote recorder device. He inserts his ballot over the directional pins and turns the pages of the ballot book. He makes his selections by pushing the stylus through the hole next to the candidate's name or question. The ballot mask blocks the voter from missing the hole. After the voter has completed making his selections he removes the ballot from the vote recorder and places it in the ballot envelope. The numbered stub is removed from the ballot by an election official. The ballot is then deposited in the ballot box.

After the polls close, the ballots are counted and checked for write-in votes by the election officials. The ballots are arranged, spindled, and then transferred to the central counting center. The tabulation process can be very complex. Examples of the election officials' duties at the precinct and the central counting center follow.

Election Officers - Punch-Card System

1. Check each of the voting devices to see that the pages and seals are still intact.

2. Determine the number of unused ballot cards by reference to serial numbers or by manual count. Enter the total of unused ballot cards on the Ballot Card Transfer Case Statement in the space marked "No. of Unused Ballot Cards."

3. Remove seal from metal ballot box containing voted punchcards and count the ballots while still in their envelopes. The number of cards counted must agree with the number of voters recorded in the Poll.

4. Compare the voter's signature on the envelope with the signature on his registration record.

5. If the signatures compare, check to be sure that registration record has been stamped with the date of the election, and the letters "AV"

6. Print the voter's name on an application to vote and print the letters "AV" after the name.

7. Remove the ballots from the envelopes and write the ballot numbers on the Application to Vote.

8. Tear off and destroy the numbered corners from all ballots.

9. Write the voter's name, the ballot numbers and the letters "AV" in the poll book as shown on the Application to Vote Book. Enter the total number of voted ballot cards counted on the Ballot Card Transfer Case Statement in the space marked "No. of Voted Ballot Cards."

10. Open ballot envelope and check for "Write-In Votes". If NONE EXISTS, remove ballot from envelope and inspect card for damage. Place good ballot cards in a pile with the clipped corner in the same position on all cards. Place damaged ballot cards, if any, in a second pile.

    Place envelopes with No Write-In votes in a third pile. If a WRITE-IN VOTE EXISTS, keep card in envelope and place in a fourth pile. (Be sure to remove all cards from envelopes EXCEPT those where a "WRITE-IN" vote exists.)

11. Place damaged cards, if any, in ENVELOPE A (do not seal envelope) and place in metal ballot card transfer case.

12. Place VOTED BALLOT CARDS neatly, secured with a rubber band, into metal ballot card Transfer Case.

13. Place BALLOT ENVELOPES, which do not contain "Write-In" votes, in metal ballot card Transfer Case.

Source: Analytic Systems, Incorporated, A Study of Election Difficulties in Representation American Jurisdictions, Prepared for United States General Accounting office, office of Federal Federal Elections, (Vienna, Virginia: Analytic Systems Incorporated, 1974), pp. IV-14, IV-16, IV-17.

COUNTING CENTER (CES System)

The Counting Center consists of the following responsibilities:

1. Receiving
2. Inspection
3. Write-In
4. Duplication
5. Data Processing

RECEIVING checks in the ballot boxes and logs pertinent information such as: precinct number, time arrived, condition of the seal and signatures of releasing and receiving officials. They deliver the ballot boxes to the INSPECTION Board.

INSPECTION breaks the ballot boxes seals, removes the ballot cards, checks the ballots, removes any hanging chad by fanning and removes any damaged ballots for judication. A damaged ballot is one which is bent, torn, or creased in any manner which would prevent it from feeding through the computer.

WRITE-IN sequentially numbers the envelope and ballot card for purposes of auditing. Write-ins are manually tallied. Ballot cards are checked for over-vote against a sample ballot. An over-vote occurs either when a voter has punched more votes than the number allowed for an office, or the voter has punched the correct number of votes on the ballot, in addition to writing-in a candidate's name for that office. On this card, the voter only punches one vote, but he also writes in a candidate's name for that office on the envelope. To correct, the write-in envelope is voided and the ballot card remade or that section of ballot may be over voted.

DUPLICATION reproduces the damaged ballots by placing the damaged ballot in a port-a-punch device. Under the ballot to be duplicated, a prescored ballot card marked "duplicate" is placed. One team member calls out the number to be punched: while the other, beginning on the left side of the ballot, punches out each clip seen

through the original ballot. The duplicated ballot may then be sight checked against the light. Reproduced damaged ballots are all sequentially numbered. DATA PROCESSING places the ballot cards in the card reader with the proper program header card and the election results appear on a print-out sheet which reveals the results by precinct and finally the total election results.

Source: Computer Election Systems

The computer programs which control the vote tallying process must be especially prepared for the candidates and questions on the ballot. Different programs are required to tally the vote for each precinct. In most jurisdictions two computers are used to be sure of a backup in case of computer failure.

Punch card systems have the lowest initial cost of any system. Each device costs between $140 and $240 depending on the vendor. Most of the jurisdictions using a punch card system already have a computer. Other costs of the system are: preparation of the ballot, preparation of the programs and test desks, professional computer personnel salary, transportation to the central tallying center, security, and replacement of vote recorders.

Approximately 177 cities and counties in 21 different states now use the punch card system.[4]

Advantage of the Punch Card System

(1) Punch card systems have the lowest initial cost.

(2) There is a reduction of cost for storage and transportation.

(3) Machine failures due to mechanical breakdown are eliminated.

(4) There is a lower investment required for additional machines to accommodate increasing voter population.

(5) More vote recorders can be set up to handle more voters per precinct.

Disadvantages of the Punch Card System

(1) The ballot must be arranged in book form, requiring the voter to turn pages and follow a very complex set of instructions to match candidates with the unnumbered spaces of the punch card.

(2) The ballots must be transported for counting, causing opportunity for possible fraud. Some jurisdictions have used police protection for the ballots.

(3) At the counting center, highly trained professional officials process the ballots with a computer. The integrity of the election count is no longer subject to the check and inspections of many officials.

(4) All of the punch card systems protect against vote loss through overvoting.

(5) All punch card ballots are subject to the liabilities of any paper ballot such as chain voting or tampering.

(6) Testing the computer program involves preparing test desks for every office, candidate, and question. This process takes several days for the staff to prepare and test.

(7) Spoiled ballots must be duplicated. This adds to the cost of personnel at the counting center. Ballots are considered spoiled when they have been bent, folded, mutilated or have become damp due to perspiration or humidity.

(8) The ballot preparation and vote tabulation phase requires detailed planning and coordination by election officials.

(9) The introduction of a punch-card system would require voter education.

(10) There is a limited availability of computers for processing.

(11) The punch card system is cheaper to purchase initially but there is a high cost of operation.

(a) Computer time costs approximately $500 per hour if a government computer is not available.

(b) There is the expense of preparing test desks and computer programs every election.

(c) Printing the ballot page assemblies for each vote recorder for each election is expensive.

(d) The pre-election costs include the expense for cutting the mask, "crimping" the ballot pages onto metal rods, which must be then set into the machine frame, which then must be set into each individual machine.

(e) Election worker costs are higher since people are needed to check ballot conditions and to duplicate ballots.

Optical Scan Systems

In the late 1950's Los Angeles County appropriated $1,000,000 to research and develop a method to expedite paper ballot counting. This research led to the development of the optical scan system by the Norden Division of United Aircraft. The system was purchased and marketed by Coleman Systems until 1971. Gyrex

Corporation, which has been a subcontractor for system parts, has taken over the manufacturing and distribution of this system since 1971.

A second optical scan system was developed by the Votronic Corporation in the early 1960's. Votronic Corporation was acquired by Cubic Corporation in 1964. Control Data Corporation has been testing its 921 Optical Character Scanner and it is now in use in the District of Columbia.

Optical Scan systems combine the concepts of electronic data processing with the use of a paper ballot. Although three different companies manufacture and distribute the system, all optical scanning equipment operates under the same principle.

The voter casts his vote on a conventional paper ballot with a special fluorescent ink stamping device. The optical scan equipment can process ballots from 10 to 30 inches in width, with each ballot column consisting of a maximum of 50 voting squares. The minimum column width required is 2 1/2 inches. The ballot may contain up to ten columns as long as the width does not exceed 30 inches. The length of the ballot must always be 24 inches long. The only different characteristic from the traditional paper ballot is the presence of clock tracks consisting of alternating black and white regions on the outer edges of the ballot. These tracks instruct the electronic processor on the location and position of each line of the ballot.[5] An example of an optical scan ballot is shown in Exhibit D.

If error in voting occurs, the voter may obtain a new ballot, and the first ballot will be voided. The same ballot used on election day can be utilized for absentee voting purposes.

An optical scan system consists of several units. Two ballot readers are required, each capable of reading paper ballots at a rate of 600 per minute. The reader electronically scans and reads ballots from one precinct, while the other reader is being loaded with the ballots from the next precinct. Although additional readers may be used, the computer will accept input from only two readers simultaneously. Two control units are needed to sort up to 999 votes cast for a maximum of 500 candidates and questions from the ballot readers. Two operator consoles are required to provide for the mounting of high-speed, punched-tape reader and for the electrical interface between the storage and control system and the card punch. One high speed card punch is necessary.

The duties of election officials at the polling place are similiar to the duties under a paper ballot system. The election officials must be sure that the voters are using the special marking pen containing fluorescent ink. Since the ballot readers utilize an ultraviolet light optical scanning process, the failure of the voter to use the special marking device will cause the reader to overlook the votes cast. The voter places a mark by his selections, folds the ballot, and returns the ballot to the election official who places it in the locked ballot box.

After the polling place closes,the election officials unfold the ballots and tabulate only the write-in votes. Write-in votes can be processed by the ballot reader. The election officials stack the ballots on a spindle tray, then seal the trays in a box, and deliver the ballot box to the designated tally center.

The spindled ballots for each precinct are removed from the trays at the tally center. The trays are checked for alignment on the spindle boards, and

placed on a conveyor track which feeds into a conveyor belt. The entire tray of ballots from each precinct is then placed into the ballot reader along with the precinct program card which contains the precinct number, and with the punched paper tape program which informs the computer processor of the corresponding ballot type, the location of the offices and issues, the maximum number of votes permitted for each office and issue, and the ballot rotation sequences. An operator sets the precinct number shown on the ballot tray into a set of switches on the ballot reader. The switch number and the precinct number on the program card must be identical. Each ballot passes through the reader,and an image of its votes is transferred to a memory unit in the processor. The votes are then analyzed to determine if any office or issue has been over-voted, based on the specification set forth in the precinct tape program. The processor also performs validity checks to assure that the ballot has been properly and completely read.[6]

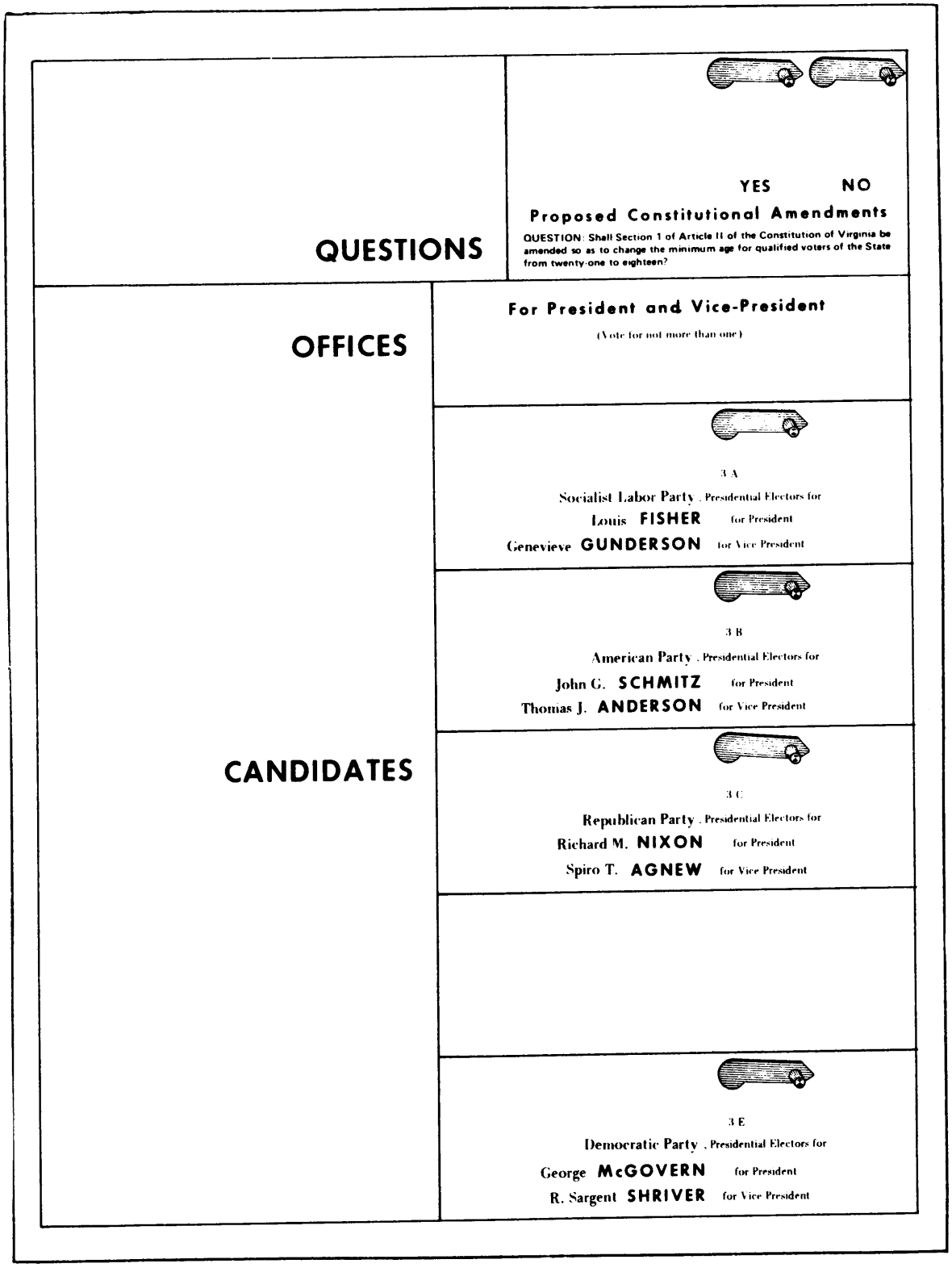
The system keeps an accurate count within each precinct of any ballot it fails to tally. The system indicates each unread ballot by marking a red stripe on the back of the ballot. Any such ballots,which are easily identifiable,can later be processed through the reader or can be manually counted. After the precinct ballots have been read and processed, the totals of the offices and questions are automatically punched into tabulating punch cards.

The ballot requirements and systems specifications of the Cubic Votronic system are different from those of the Coleman/Gyrex system. Cubic Votronic counters are self-contained reader and processor units which permit their use at more than one tally center.

The use of the ballot reader voting system is limited. The Coleman/Gyrex is utilized in three metropolitan counties: Multnomah County, Oregon; Hamilton County, Ohio; and Orange County, California. The Cubic Votronic Vote Counter system is also used in three counties, all in California: Alameda, San Diego, and Santa Clara. [7]

The advantages and disadvantages of the optical scan system are much the same as the punch card system, as a paper ballot is utilized in both systems.

AUTOMATIC VOTING MACHINE BALLOT



An Automatic Voting Machine ballot face from Arlington County, Virginia

Source: **ELECTIONEWS,** November 1972

Exhibit A

SHOUP VOTING MACHINE BALLOT

1ST PULL RED HANDLE RIGHT TO CLOSE CURTAINS
2ND MARK YOUR BALLOT AND LEAVE MARKS SHOWING
WARNING – YOUR ☒ MARKS MUST BE SHOWING FOR VOTE TO REGISTER
3RD PULL RED HANDLE LEFT

	November 7, 1972 **Democratic** Column 1	November 7, 1972 **Republican** Column 2	November 7, 1972 **Socialist Labor** Column 3	November 7, 1972 **Communist** Column 4
FOR PRESIDENT OF THE UNITED STATES FOR VICE-PRESIDENT OF THE UNITED STATES (Vote for One)	GEORGE McGOVERN ☐ R. SARGENT SHRIVER	RICHARD M. NIXON ☐ SPIRO T. AGNEW	LOUIS FISHER ☐ GENEVIEVE GUNDERSON	GUS HALL ☐ JARVIS TYNER
FOR UNITED STATES SENATOR (Vote for One)	ROMAN PUCINSKI ☐	CHARLES H. PERCY ☐	EDWARD C. GROSS ☐	ARNOLD F. BECCHETTI ☐
FOR GOVERNOR FOR LIEUTENANT GOVERNOR (Vote for One)	DANIEL WALKER ☐ NEIL F. HARTIGAN	RICHARD B. OGILVIE ☐ JAMES D. NOWLAN	GEORGE A. LaFOREST ☐ STANLEY L. PROROK	ISHMAEL FLORY ☐ THEODORE PEARSON
FOR ATTORNEY GENERAL (Vote for One)	THOMAS G. LYONS ☐	WILLIAM J. SCOTT ☐	GEORGE P. MILONAS ☐	LINDA R. APPELHANS ☐
FOR SECRETARY OF STATE (Vote for One)	MICHAEL J. HOWLETT ☐	EDMUND J. KUCHARSKI ☐	ELIZABETH SCHNUR ☐	FRANCES GABOW ☐
FOR COMPTROLLER (Vote for One)	DEAN BARRINGER ☐	GEORGE W. LINDBERG ☐	CLARYS L. ESSEX ☐	NATHAN SHARPE ☐
FOR TRUSTEES OF THE UNIVERSITY OF ILLINOIS (Vote for Three)	ELLEN AUGUSTYN ☐ NICHOLAS J. BOSEN ☐ ROGER B. POGUE ☐	RALPH C. HAHN ☐ JANE S. HAYES RADER ☐ PARK LIVINGSTON ☐	EDWIN L. WILLIAMS ☐ GREGORY P. LYNGAS ☐ HENRY SCHILLING ☐	JACK KLING ☐ JOHN ROBERT LUMPKIN ☐ WILLIAM R. FUGATE ☐

A Shoup Voting Machine ballot face from Cook County, Illinois

Source: **ELECTIONEWS,** November 1972

Exhibit B

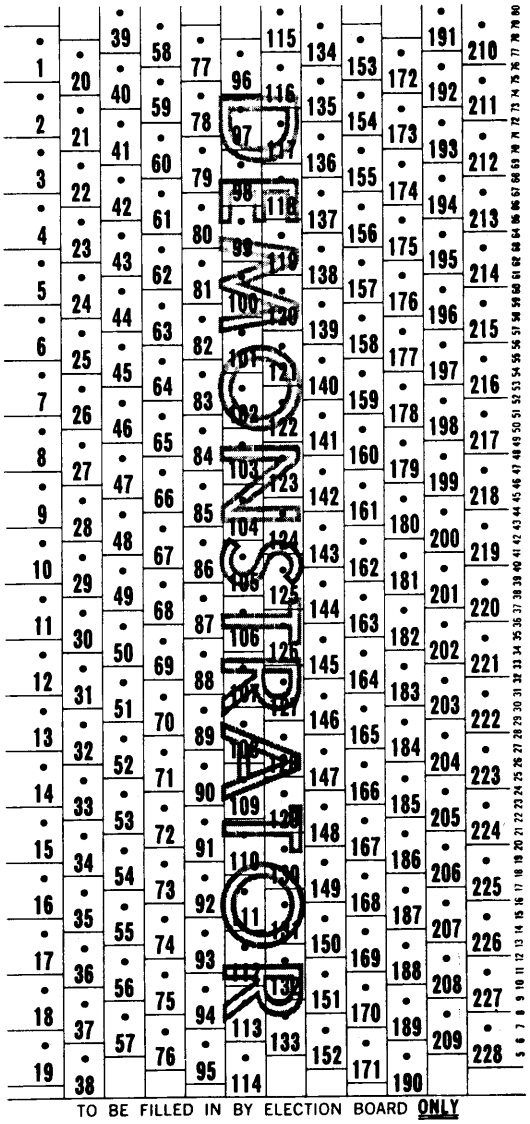
PUNCH CARD SYSTEM BALLOT

INSERT CARD  **THIS SIDE UP**

FOR DEMONSTRATION USE

ONLY

THIS BALLOT STUB SHALL BE REMOVED
BY INSPECTOR BEFORE BALLOT IS PLACED IN BALLOT BOX.



TO BE FILLED IN BY ELECTION BOARD **ONLY**

PRECINCT NO._____WRITE-IN NO._____

Exhibit C

OPTICAL SCAN SYSTEM BALLOT
(Data-Vote System)

MUNICIPAL BALLOT

CITY AND COUNTY OF SAN FRANCISCO

18TH ASSEMBLY DISTRICT

Tuesday, November 2, 1971

This ballot stub shall be removed by the inspector before the ballot is placed in the ballot box.

CITY AND COUNTY

District Attorney	Vote for One
JOHN JAY FERDON District Attorney	⊕
	⊕

Sheriff	Vote for One
WILLIAM C. BIGARANI Inspector of Police, (Sergeant)	⊕
MATTHEW C. CARBERRY Sheriff of San Francisco	⊕
RICHARD DUANE HONGISTO Criminologist	⊕
MATTHEW "MATT" O'CONNOR Law Enforcement Administrator	⊕
	⊕

Member of the Board of Education		
Nominated by Mayor for Confirmation by Electors GEORGE Y. CHINN	YES	⊕
	NO	⊕
Nominated by Mayor for Confirmation by Electors DR. EUGENE S. HOPP, M.D.	YES	⊕
	NO	⊕

MEASURES SUBMITTED TO VOTE OF VOTERS			
A	PUBLIC SCHOOL BUILDING BONDS, 1971. To incur a bonded indebtedness of $56,180,000 for the improvement of the public schools in the City and County of San Francisco, including additions to and reconstruction, replacement, alteration and improvement of existing school buildings and educational facilities.	YES	⊕
		NO	⊕
B	HARBOR IMPROVEMENT BONDS, 1971. To incur a bonded indebtedness of $34,000,000 for the improvement of the Harbor of the City and County of San Francisco and its facilities.	YES	⊕
		NO	⊕

102-18 VOTE BOTH SIDES

Exhibit D

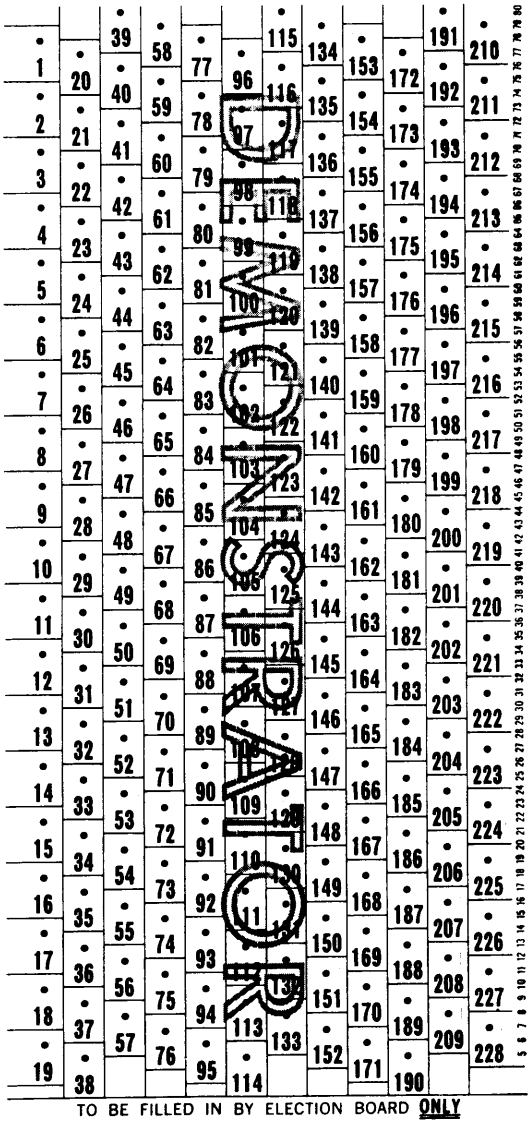
PUNCH CARD SYSTEM BALLOT

INSERT CARD  **THIS SIDE UP**

FOR DEMONSTRATION USE

ONLY

THIS BALLOT STUB SHALL BE REMOVED
BY INSPECTOR BEFORE BALLOT IS PLACED IN BALLOT BOX.



TO BE FILLED IN BY ELECTION BOARD **ONLY**

PRECINCT NO._____WRITE-IN NO._____

Exhibit C

OPTICAL SCAN SYSTEM BALLOT
(Data-Vote System)

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JOHN JAY FERDON District Attorney	⊕
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Sheriff	Vote for One
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MATTHEW C. CARBERRY Sheriff of San Francisco	⊕
RICHARD DUANE HONGISTO Criminologist	⊕
MATTHEW "MATT" O'CONNOR Law Enforcement Administrator	⊕
	⊕

Member of the Board of Education		
Nominated by Mayor for Confirmation by Electors GEORGE Y. CHINN	YES	⊕
	NO	⊕
Nominated by Mayor for Confirmation by Electors DR. EUGENE S. HOPP, M.D.	YES	⊕
	NO	⊕

MEASURES SUBMITTED TO VOTE OF VOTERS		
A PUBLIC SCHOOL BUILDING BONDS, 1971. To incur a bonded indebtedness of $56,180,000 for the improvement of the public schools in the City and County of San Francisco, including additions to and reconstruction, replacement, alteration and improvement of existing school buildings and educational facilities.	YES	⊕
	NO	⊕
B HARBOR IMPROVEMENT BONDS, 1971. To incur a bonded indebtedness of $34,000,000 for the improvement of the Harbor of the City and County of San Francisco and its facilities.	YES	⊕
	NO	⊕

102-18 VOTE BOTH SIDES

Exhibit D

Chapter III

Comparison of the Systems

The three mechanical systems can be compared in the areas of cost; preparation for elections; peripheral equipment; casting the ballot; and the vote tallying systems.

Cost

It is most difficult to compare the cost of vote counting equipment due to the fact that the systems are not really comparable in function. The lever voting machine is a balloting and counting system in one machine. Punch card systems are basically a ballot holder with a stylus attached. A computer is required to count the data processing ballots, regardless of the vote device used. The optical scanning system is a ballot counter, and the only equipment required is the ballot and a special marker. Mechanical devices are required for counting.

There are many other factors related to cost besides the capital investment of the equipment used in the precincts. Other factors are:

(1) storage;
(2) transportation of equipment;
(3) cost of preparing the ballot;
(4) peripheral equipment;
(5) election day precinct operating costs; and
(6) tally system costs.

Lever voting machines require a large capital investment. They also require substantial storage and transportation costs, plus some maintenance. Storage is the largest source of difference in annual operating costs. Lever machines are

the only system that provides an immediate count as soon as the polls are closed. Lever machines also protect the voter against over-voting, greatly limit the opportunity for fraud, and have more than a 40-year life expectancy. With lever machines, there is a reduction in the number of people needed per election and a shortening of hours worked by the people.

If one machine serves 400 registered voters in a precinct twice a year for 30 years, it is of potential use to 24,000 voters. This means that it costs less than ten cents in capital expense to accommodate each registered voter on each lever machine for each election for the life of the machine. If the number of elections is greater than two a year, as is the case in Kentucky, then the cost per voter per election is even less.[1]

Cost of Lever Voting Machines (AVM)[2]

Capital Equipment

AVM-30	office	column size (non-printer)	$1,931.00
AVM-40	office	column size (non-printer)	$2,103.00
AVM-50	office	column size (non-printer)	$2,270.00
AVM-60	office	column size (non-printer)	$2,409.00
AVM-30	office	column size (Print-o-Matic)	$2,150.00
AVM-40	office	column size (Print-o-Matic)	$2,328.00
AVM-50	office	column size (Print-o-Matic)	$2,495.00
AVM-60	office	column size (Print-o-Matic)	$2,634.00

Supplies

Vendor estimates all associated supplies to hold an election can be purchased for:	$5.00 per election unit

Service

For two elections after purchase:	No charge

Service (cont.)

ballot layout and printing assistance machine programming training of machine custodians training of precinct officials supervision of voter education After that: AVM will still provide these services but will charge based on what is to be done	Varies

Punch card systems offer a method of casting a ballot which can be counted by computer. Punch card systems have become popular because they require much smaller capital expenditure, provide for a greater number of units at each polling place, and are easier to transport and set up than lever machines. Punch card systems, although requiring less capital outlay, cost more to operate, including the computer programs, ballot forms, ballot cards and other equipment.

Punch card ballots that have been mishandled must be duplicated. This adds another expense in personnel salaries and raises objections by persons who question the accuracy of the duplicating procedure. Other costs added under the punch card systems are manpower requirements, training costs, voter education costs, and security costs. Technical security must be initiated under this system.

Computers may represent no additional capital expense for a local government because they are already in use for general governmental purposes. When employing governmental computers, consideration must be given to the situation where no other computer processing can be performed during the time-frame assigned for election processing. Jurisdictions with on-line operations, such as police systems, may find this a problem.

The cost of a private computer is approximately $500 per hour. Using private systems creates added administrative burdens and requires additional

security. A backup computer is always necessary because of mechanical failures and computer down time.

The punch card system becomes more expensive with an increase in the number of elections and the more complicated the ballot. The fewer the elections and the simpler the ballot, the greater the impact of the capital expense required to install the lever voting systems or the optical scanning devices. The cost of all systems depends on local factors, as well as the vendor's equipment costs. It is not possible to state conclusively that one system is less expensive than another system for any individual jurisdiction.

Cost of the Punch Card System (CES)[3]

Capital Equipment

Model I Votomatic	$140 - 168 each
Model IIIA Votomatic	$210 - 230 each
Demonstrators	$45 each
Ballot Tab (small computer)	$20,000 approx.
BMX Ballot Multiplex unit	$64,500 - $84,500 approx.
Ballot Assembly Aid - only need 1	$125 each
Crimper Automatic - to crimp hinges	$980 each
Crimper Manual	$185 each
Mask Punch, Gang	$3,650
Mask Punch, Single Row	$880
Transfer Cases - One per precinct	$9.40 each

Supplies

Ballot security envelopes - re-useable except for write-ins	$9 - 15 per k
Yellow masks - 1 per machine each election	$ .35 each
Demo cards - approximately 50 per precinct	$25 per k
Ballot cards - left-overs can be used in some states	$20 per k, approx.

Supplies (cont.)

Seals - 1 per ballot box and 1 per each voting device	$ .10 each
Crimp hinges - 1 per page = 7 per votomatic, not reusable	$35 per k
Styrofoam backed for absentee ballot which is Estimated 4% of vote	$ .03 - .08 each
Punch for absentee ballot	$ .02 each
Yellow mask - gang punching service	$ .02 each
For one election and observation of second:	Free

Ballot Design and Assembly
Coordinating with Data Processing Training Staff
Training Precinct Judges
Coordinating Voter Education
Written Procedures
Assistance where necessary
Set-up and Maintenance of Lever Systems — $12.00 per hour

Programming for Tallying up to

250	precincts - $5.00 per precinct	+ $5.00 per candidate
250 - 500	precincts - $4.00 per precinct	+ $4.00 per candidate
500 - 750	precincts - $3.00 per precinct	+ $3.00 per candidate
750 - 1,000	precincts - $2.00 per precinct	+ $2.00 per candidate
over 1,000	precincts - $1.00 per precinct	+ $1.00 per candidate

Minumum price — $350.00
All prices FOB - Berdeley, California

5 year lease - 9% interest on unpaid balance

The optical scan systems provide a method of counting paper ballots at high speeds. The equipment also requires a substantial financial investment as well as operating space. The size of the capital investment restricts the desirability of optical scan systems to fairly large jurisdictions.[4]

Optical scan systems are subject to the same printing charges that paper ballots incur, which may be very high for jurisdictions which are required by law to have ballot rotation. This necessitates large numbers of small printing runs.

Cost of Optical Scan System (Gyrex)[5]

Capital Equipment

Gyrex 3021 Vote Tally System (2 readers)	$1,155,000.00
Gyrex 3022 Vote Tally System (2 readers)	$1,556,000.00
Single Printing Chase	$ 3,200.00
Double Printing Chase	$ 4,600.00

Supplies

Gyrex Marking Stamps	$ 3.00 each
Re-Inked Marking Stamps	$ .50 each
Gyrex Spindle Trays	$15.00 each

Service

For one election:	Free
operator training	
ballot printing assistance	
general assistance	
installation	
State Approval	
EDP Staff to set totals	
After that:	Varies
Gyrex will continue to provide service charging on what needs to be done	

Preparation for Elections

Set-up procedures differ for each system. Lever machines require placing the ballot face on the machine and programming the machine to match the ballot. Programming a lever machine prevents over-voting. Punch card systems require that masks be affixed to the voter recorder and the ballot pages be attached. The masks must be punched to correspond to the ballot pages. The optical scan system requires no set-up procedure.

Punch card systems also require set-up for the tallying process. Program cards must be prepared for each ballot situation. Ballot rotation,required by law in many states, highly complicates this task. Special programs must be prepared

for the optical scan system to provide processing instructions for each ballot format for the optical scan device.

All three mechanical systems require testing to insure that the system is operating properly. Lever machines are tested to see that over-voting cannot occur and the counters are functioning properly.

Punch card vote recorders must be tested to see that the masks and ballots are compatabile. A test deck must be assembled to test the election program. Cards must be punched to test every combination of votes that could be cast. These votes are then processed against the tallying system and compared to a manual count.

Tests are conducted on the optical scan system by marking and hand tabulating sample ballots. The ballots are then processed using a program sheet or tape to assure each ballot configuration will tally or be counted by the computer.

Peripheral Equipment

There are supplies necessary for each election for each of the three mechanical voting systems.

The supplies required for each election using lever voting machines are:

(1) Seals
(2) Paper rolls for write-ins
(3) Ballot faces
(4) Interlocks for programming machine
(5) Printed papers for absentee voting

The supplies required for each election with the punch card system are:

(1) Prescored numbered ballots
(2) Ballot envelopes (may be reused if there are no write-in votes)
(3) Masks to program vote recorders

(4) Demonstration ballot cards
(5) Test ballot cards
(6) Seals
(7) Crimp hinges
(8) Computer program
(9) Computer paper

The supplies necessary for the optical scan system are:

(1) Printed ballots
(2) Test ballots
(3) Marking instruments
(4) Computer program
(5) Computer paper

Some of the punch card manufacturers offer computer program packages. CES provides an on-going subscription service for a fee. Accuvote, Datavote, and Fidlar and Chambers will sell a one-time program.

Casting Ballot

The optical scan system is the easiest system to operate since the voter is merely required to mark a paper ballot with a special stamp. This system is subject to the liabilities of any paper ballot,such as,tampering or chain voting.

The lever voting machine does eliminate the chance of human error on the part of both the voter and election official. The lever machine is programmed to prevent the possibility of over-voting. Only the voter handles the levers that mark his selections.

Punch card voting is much more complicated than either optical scan or lever voting machine systems. Using the punch card system,the voter first must slide the ballot card into the vote recorder,making sure the two holes at the top of the card fit over the direction pins. The ballot is in book form,and the voter must follow a complex set of instructions,turning the ballot pages and punching

the selections with a stylus. The print on the data processing card is very small, and some vendors supply a magnifying glass front for the ballot.

A comparison of the steps taken by the voter using the lever machine and the punch card system follows:

Lever Machine	Punch Card
1. Sign Registry	1. Sign Registry
2. Enter Booth	2. Receive Punch Card and Envelope
3. Turn lever to close curtain	3. Enter Polling Booth
4. Pull levers for candidates or straight party lever	4. Place punch-card over direction pins in recorder
5. Write in candidates on space provided on machine	5. Turn ballot pages to show candidates and questions; punch hole with the same number as candidate; request new card if is made.
6. Turn lever back to open to register vote and open curtain	6. Write-in on separate envelope Review Card from Vote Recorder
	7. Insert card in envelope
	8. Return envelope to election officer who reviews stub
	9. Deposit ballot in ballot box

Vote Tallying

The lever voting machine provides a minimun of tallying problems since votes are tallied at each machine. Totals are then taken to a central point for tallying. Very few people are involved in obtaining the final results. The necessity for checking for overvotes is entirely eliminated since overvoting is not possible on a lever machine.

More tallying staff is required for the punch card and optical scan systems since these systems process individual ballots while the lever voting machine system processes machine totals. In both the punch card and optical scan systems, the mechanical devices are utterly impartial,but the possibility for error is greatly enlarged because of the necessity of transporting the ballot from the precinct to the processing center, and the possibility of more tampering of the processing is present in several locations. Negligence or lack of tight security in transportation and at the processing centers could result in fraud.

In both systems,the ballots must be spindled in the right order and direction, at the precinct,by election officials. The card reader will abort ballot trays with serious spindling problems. Precinct election officials must account for all ballots,whether good, voided or not used. All this processing must be completed by the officials after the polls close.

The ballots must be examined at the counting center to insure that the ballots have not been damaged. The computer will reject defective ballots that have been bent or chewed or have a moisture content,usually due to perspiration. The data processing cards should be kept in controlled temperatures,but ballot boxes are not moisture-proof,and polling places usually are not air-conditioned. The ballots also must have a clean hole punch; any hanging chad will keep the ballot from going through the card reader. Damaged ballots that cannot be machine counted must be duplicated.

The ballots are physically handled again for machine input to convert the ballots to magnetic tape. The tape may require additional manual handling to trans-

port it from the card reader to a computer facility. In the mechanical systems where many people are involved in the tallying procedure with the use of sophisticated equipment, more security is required.

Chapter IV

Research

The research currently being conducted on vote counting equipment is devoted to new methods and not refinement of existing systems. Several different companies are involved in the production and marketing of new vote counting systems. The voting systems are each of a different variety.

The R. F. Shoup is a new lever voting system which is similar to other lever voting machines but is considerably lighter. This machine weighs 268 pounds; other lever voting machines average in weight about 700 pounds. The largest model provides for 350 candidates or 150 referendum issues. There are adequate accommodations for write-in votes. This machine sells for $1,675, which is less than other lever voting machines.[1] Transportation and storage costs are also reduced due to size and weight.

The Gyrex MTB-1 is a precinct level optical scanning device. The voter marks a three-inch-wide ballot with a pencil and inserts the ballot into the Gyrex device. The MTB-1 automatically tallies the votes on the ballot before dropping it into the ballot box. Election officials insert a key to activate a printer after the polls close. The printer prints the candidates and question totals on a paper tape. The device also records the number of times a write-in was recorded, the number of over-votes, the number of unread ballots, and the total number of ballots that were read. The device can be tied to a central computer where the total votes can be accumulated during the day.

The MTB-1 weighs 63 pounds. The cost of the system varies depending

upon the number of precincts. The cost range is from $3,500 for a large order to $6,000 per unit for a small order. In order to program these devices, Gyrex also sells a program and erase device which is relatively easy to operate and can be used for set-up in each election. Program and erase devices sell for $9,000 each, but only one is required for each jurisdiction.[2] The Gyrex MTB-1 is now being utilized in District of Columbia.

The Video Voter system was designed by the Frank Thornber Company of Chicago, Illinois. This system is made up of two units, the Video Voter and the Data Center.

The Video Voter is the voting device. The ballot is a 35mm film strip which is projected on a screen on the front of the Video Voter. The ballot can consist of up to twenty individual films that contain as many as 48 voting positions on each, with a maximum of 960 ballot possibilities.[3]

The voter depresses a button under the desired candidate or question and an illuminated "X" appears. Depressing a "new page" button displays each successive page of the ballot. Use of a "review ballot button" permits the voter to review selections. The voter depresses the "voter register button" to cast his ballot.

The data center is a mini computer that is programmed with a magnetic tape held within a cassette, similar to those used in a recorder. The voter tally results are transferred to a tape after the polls close. The tape is then read to display voter positions and voter totals individually, so that totals may be manually transcribed to tally sheets.

The Video Voter unit weighs 90 pounds. When in operation, it is placed on top of its storage case, to which curtains are affixed to create a voting booth. The Video Voter requires normal electrical outlets to operate. The Data Center weighs 80 pounds. The unit can serve up to eight video voter units. The Video Voter units costs $1,600 per unit, and the Data Centers are $2,450 per unit.

The Computer Elections Systems Precinct Ballot Counter is designed to tabulate punch card ballots at the precinct level. It permits an immediate summary of precinct totals and provides for more rapid unofficial results at the precinct level. The Precinct Ballot Counter system is designed to be used in a batch processing fashion after elections.

After the polls close, election officials run the ballot card through the machine. The ballot is the same that is used in the CES Punch-Card System. Before starting to feed the cards into the counter, the election official pushes the print button which will print the precinct number and will run through all the positions on the ballot to show all counters at zero and the maximum number of votes per position per card. After it is finished, the election official will begin to feed all the cards through the right side of the machine. As each ballot is processed the Precinct Ballot Counter prints sequential ballot numbers on the adding machine-type tape used by the machine. If the ballot were fed through incorrectly, it would print "read error", and the election official would retrieve that card and run it through again. The election official has to watch the tape during the entire reading process to assure that the ballots are being read correctly.

After all the ballot cards for a precinct are inserted correctly,the print button is pushed,and the paper tape prints out all the positions,with the number of votes per position and the maximum number of allowable votes per position per card. If a second copy of the totals is required, the print button is pushed again. In order to see what candidate or what question received how many votes, the tape is attached to a preprinted listing of candidates and questions that is spaced the same as the tape.

After the counting is completed, the ballots are locked in card boxes and transported to the central counting place in the usual manner. They are then counted along with the other ballots of the jurisdiction. Since this is a precinct ballot counter, it is designed to give results to the precinct and would be most appropriate in areas where precinct totals are very important.

When this system is marketed,cost estimates range from $950 to $2,200. The price will depend on the quantity ordered. The central computer processing will not be altered as this is simply a precinct counter to give rapid precinct totals.

The International Election Systems Televote electronically tabulates votes as they are registered on the Shoup lever machine. Electronic sensors are attached to each voting spindle on the Shoup lever machine. Each time a vote is registered on a mechanical counter, the same count is registered on an electronic counter contained within a scanner. The scanner may serve more than one lever machine.

The scanner has a data phone connection which will transmit counts to

the computer. As soon as the Shoup lever machine is switched to the "polls close position", the scanner will accept a call from the computer. Counter's totals within the scanner are transmitted to the computer,which may be programmed to accept data from varying ballot formats.

The system has been developed and tested within the IES factory. It will soon be ready for implementation.

The Fidlar & Chambers' Vote Recorder is a punch-card system used for the first time on November 5, 1974. This system was observed in DuPage County, Illinois and in Franklin County, Missouri. Overall operation of the system was considered good.[4]

The Vote Recorder is a punch-card system of the Harris Votomatic type currently marketed by Fidlar & Chambers. Fidlar & Chambers acquired rights to manufacture and market the system through the purchase of Electro Mechanical Incorporated who initially purchased rights to the Votomatic from IBM.

This system is similar to other punch-card voting systems. Fidlar & Chambers does write the program for each customer for the first two elections. The program is included in the original purchase price. They also maintain test decks of ballot cards for their customers.

The Hewlett-Packard Vote Tally System is an optical scan system which will permit ballot tallying at the precinct level. The system consists of three pieces of equipment to be located at the precinct level. The Hewlett-Packard 9830A calculator and the thermal page printer are presently being used for other systems. The 9860A marked card reader was developed for this system. It has been tested but not yet sold.

The marked card reader costs $875, the 9830A calculator costs $6,475 and the thermal page printer costs $2,995. The vender feels one of the most important factors in the saleability of this system over others now being manufactured is the multiplicity of uses for a local jurisdiction.[5] All the rest of the year, different departments within a county could use the card readers and calculators for other purposes.

The Accuvote System manufactured by Accuvote International Incorporated, which should not be confused with the Accuvote punch card device marketed by Carlisle-Graphics, is a system that records each voter's choice simultaneously on mechanical counters and on punch cards for computer processing. A pilot model of this machine had been tested, but no manufacturing agreements have been made.

The Electronic Voting Machine Corporation (EVE), a subsidiary of AVM Corporation announced on May 31, 1974 the development of a punch-card voting system consisting of a precinct card reader, which provides precinct totals and a central unit to tally precinct totals. The precinct system can read either a punched card or cards marked with a pencil.

The ballot card is similar to that used by CES and other punch-card manufacturers since it contains no ballot printing. The difference in the EVE system as compared to the CES type is that it allows the voter to mark or punch his selections. EVE recommends use of the marking of ballots rather than punching.

FOOTNOTES

Chapter 1

(1) "Ballot", Encyclopedia Americana, 1972, IIVIII, 118.

(2) Analytic Systems, Incorporated, Describe, Analyze and Compare the Currently Available Methods of Vote Counting Equipment and to Make Appropriate Recommendations, Final Report, Prepared for United State General Accounting Office, Office of Federal Elections, (Vienna, Virginia: Analytic Systems, Incorporated, 1974), p. 1-5.

(3) Analytic Systems, Incorporated, Survey of Election Boards, Final Report, Prepared for United States Accounting Office, Office of Federal Elections, (Vienna, Virginia: Analytic Systems, Incorporated, 1974), p. 22.

(4) Connecticut, Delaware, Hawaii, Kentucky, Louisiana, Maryland, New Mexico, and Rhode Island.

(5) Institute of Election Administration, American University and National Scientific Corporation, A Study of Election Difficulties in Representative American Jurisdictions, Prepared for United States General Accounting Office, Office of Federal Elections, (Washington: Institute of Election Administration, 1973), p. 1-10.

Chapter 2

(1) Analytic Systems, Incorporated, Survey of Election Boards, Final Report, p. 64.

(2) Analytic Systems, Incorporated, A Study of Election Difficulties in Representative American Jurisdictions, p. 3 of Exhibit C.

(3) Analytic Systems, Incorporated, Describe, Analyze and Compare the Currently Available Methods of Vote Counting Equipment and to Make Appropriate Recommendations, Final Report, p. 1-22.

(4) Analytic Systems Incorporated, A Study of Election Difficulties in Representative American Jurisdictions, p. 3 of Exhibit B.

(5) Ibid., p. 2 of Exhibit A.

(6) Ibid., p. 3 of Exhibit A.

(7) Ibid., p. 4 of Exhibit A.

Chapter 3.

(1) Council of State Governments, The Costs of Administering American Elections, (Lexington: Council of State Governments, 1973), p. 45.

(2) Analytic Systems, Incorporated, Describe, Analyze and Compare the Currently Available Methods of Vote Counting Equipment and to Make Appropriate Recommendations, Final Report, p. 2-136.

(3) Ibid., p. 2-145.

(4) Council of State Governments, The Costs of Administering American Elections, p. 45.

(5) Analytic Systems, Incorporated, Describe, Analyze and Compare the Currently Available Methods of Vote Counting Equipment and to Make Appropriate Recommendations, Final Report, p. 2-155.

Chapter 4

(1) Analytic Systems, Incorporated, Experimental Voting System Supplement, Prepared for United State General Accounting Office, Office of Federal Elections, (Vienna, Virginia: Analytic Systems, Incorporated, 1974), p. 28.

(2) Ibid., p. 37.

(3) Ibid., p. 39.

(4) Ibid., p. 15

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