DEVELOPMENT AND VALIDATION OF SELECTION SPECIFICATIONS OF MAGNETIC RECORDING/TRANSCRIBING SYSTEMS FOR THE MISSOURI ASSOCIATE

BRADY ROBERT GRANT JR

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DEVELOPMENT AND VALIDATION OF SELECTION SPECIFICATIONS OF MAGNETIC RECORDING/TRANSCRIBING SYSTEMS FOR THE MISSOURI ASSOCIATE CIRCUIT COURTS

A Dissertation
Presented to
the Faculty of the Graduate School
University of Missouri-Columbia

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy

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by
R. Grant Brady
August 1977

Arni Dunathan — Dissertation Supervisor

The undersigned, appointed by the Dean of the Graduate Faculty, have examined a thesis entitled

DEVELOPMENT AND VALIDATION OF SELECTION SPECIFICATIONS OF MAGNETIC RECORDING/TRANSCRIBING SYSTEMS FOR THE MISSOURI ASSOCIATE CIRCUIT COURTS

presented by R. GRANT BRADY

a candidate for the degree of DOCTOR OF PHILOSOPHY

and hereby certify that in their opinion it is worthy of acceptance.

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UNIVERSITY OF MISSOURI-COLUMBIA

THE GRADUATE SCHOOL

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WE HEREBY RECOMMEND THAT THE THESIS BY

R. Grant Brady

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BE ACCEPTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR

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CHAPTER I

INTRODUCTION

The courts of the United States, both Federal and State are now being confronted with an ever growing caseload. "Since 1960 the number of crimes have more than doubled," rising from three to eleven million. During the first half of 1976 alone, crime increased by three percent (Information Please Almanac, 1977, p. 48). This rise in crime rate and a growing trend for Americans to sue is creating an increase in court cases. The Eastern Missouri District of the Federal Judicial System last year increased its case load from 1428 to 1960 (St. Louis Post Dispatch, Nov. 14, 1976). U.S. News and World Report stated that Civil suits filed in all Federal District Courts are up 49.6% since 1970 (U.S. News and World Report, July 18, 1977, p. 86).

This growth as well as new interpretations of the Federal and State laws which have lengthened the time for processing a case, have caused a backlog in our courts. An example of such a law is State Rule 27.26 (Missouri Rules of Criminal Procedures, 1976, 27.26).

This court rule provides a sentenced individual the right to have his trial reviewed to determine if the sentence was unjust. Simple check sheets are often provided in confinement for filing such an appeal. If the prisoner is indigent, the court will appoint counsel to conduct the appeal.

All parties receiving an unfavorable decision in court have the right to have that decision appealed to a higher court for review. Inherent in the right of appeal is a preservation and compilation of a verbatim record of what occurred during the proceedings. Presentation to a reviewing court of such verbatim record (transcript) is necessary to pass upon allegation of error. Because the allegation must be viewed in the context of the entire trial, a complete transcript of the trial is most often required.

Not all courts have the capability to prepare a transcript. For example, in Missouri, many Magistrate Courts do not presently have a system for verbatim transcript preparation. If the losing party in this court wishes to exercise his right to appeal, the entire case must be re-tried in a higher court, such as the Missouri Circuit Courts, which have court reporters for transcript preparation. This is time consuming, costly and adds to the growing case backlog.

Audio recording equipment installed in the courts for verbatim transcript preparation has been proposed to solve the re-trial problem and cut case backlog at a minimum expense. Courts' experiences with audio recording has been limited when compared to business use of audio dictating equipment and home and professional use of audio high fidelity recording equipment.

In 1952, Puerto Rico purchased and installed forty-nine (49) recorders in the district courts which previously had no court recording system (Rodebaugh, 1953, p. 289). On October 8, 1952, the New York Board of Estimate installed a magnetic court recording system because of increasing difficulty of obtaining qualified stenotype reporters (Rodebaugh, 1953, p. 288). In 1958, the Federal Conference of the United States, the Administrative Office of the United States Courts recommended that under certain circumstances electronic recording systems be supplied for use in the U.S. District Courts (Rodebaugh, 1961, p. 1185). When Alaska became a state in 1959 the Supreme Court adopted a rule that made electronic recording the exclusive method of preserving the record in all courts (Reynolds, 1970, p. 1080). In later years, courts in New Jersey, Michigan, California, Nebraska and Massachusetts began using court recording equipment.

A few studies have been completed testing the quality of the magnetic court recording systems. Most of the tests were simple recording-playback evaluations with no statistical control. A test was completed by the U.S. Navy Office of the Judge Advocate General in July 1952 (Rodebaugh, 1953, p. 289). Three one-channel machines were tested. The machines were reported to perform unsatisfactorily due to the inability to discern the voices of two people speaking at the same time.

A survey and electrical recording test was compiled in 1960 by the Administrator's Office of the United States. The report, The Court Reporting System in the United States District Courts 1960 concluded that reliance on high fidelity recordings of proceedings is feasible (Rodebaugh, 1961, p. 1185). A test of the implemented Alaska System in 1961 also showed positive results (Rodebaugh, 1961, p. 1185).

A limited number of tests were designed to compare the recording and transcribing capability of audio recording systems to stenographic court reporters. These tests were planned to compare the accuracy of the final transcripts of each system.

In 1960, Connecticut Courts tested the comparative quality of court reporters and magnetic recording machines.

The results of the tests led the judges to decide to dispense with electronic magnetic recording (Rodebaugh, 1961, p. 1187). A comparison of recording/transcribing speed and quality of electronic court recording systems and court stenotype reporters was completed in Los Angeles Superior Courts in 1972. The resulting report, Recording and Transcription of the Los Angeles Superior Court Proceedings, concluded "The results of these tests indicate that a combination of various systems, both stenographic reporter and electronic recording systems, may provide the best operational and most cost-effective means of recording and transcribing Los Angeles Superior Court Proceedings" (A Study of Court Reporting, 1973, p. 10).

Due to these ambiguous findings of the Los Angeles test an additional test was completed in the Sacramento Superior Courts in 1973. The test compared the transcription errors of types of multi-track audio recording equipment and court stenotype recorders. The test report, A Study of Court Reporting, concluded that multi-track audio recording is superior to Stenotype recording in transcript error rate.

A study completed by the Massachusetts District Courts in 1973, Report on Preservation of Testimony in Proceedings in the District Courts of Massachusetts, determined multi-track audio recording to be an accurate

and economical system for preservation of the record. The report declined to discuss the testing procedure but defined specifications for recording equipment.

Many other unpublished tests culminated in specifications adopted by state courts for purchasing multitrack audio recording equipment. Specifications were generated by New Jersey, California, and Nebraska.

The state of the art of magnetic recording equipment has been changing rapidly since its introduction into the United States in 1947 (Jorgensen, 1970, p. 5). The quality of recording machines and microphones increased rapidly as new electronic tubes were invented and as transistors were refined (Tremaine, 1973, pp. 439-522). The reliability of the recorded product increased as new plastics were developed and better magnetic particles were invented, providing more easily stored tape (Tremaine, 1973, pp. 760-761).

Developments in magnetic recording technology since the beginning of its use in court recording have been significant. Multi-channel recorders using thinner, more inexpensive tapes have been developed. Transistors and integrated circuits have decreased the size of the recorder and its components. More compact tape formats such as the cassette have been invented. Many refinements in recorder controls such as foot pedals with automatic

backspace and monitoring capability are now available. Many features are now found on magnetic court recording equipment which were not available even during the most recent court tests.

The 78th Missouri General Assembly, perhaps realizing the advantages of electronic court recording equipment and the lack of court reporters in the associate Circuit Courts, included in House Bills 1317 and 1098 the following statements:

> Section 2. In any case assigned to a magistrate or judge by a circuit court as provided by law, the magistrate or probate judge shall utilize electronic, magnetic or mechanical sound or video recording devices or a court reporter or a stenographer for the purpose of preserving the record. The method of preserving the record in each such assigned case shall be specified by the assigning judge at the time he enters his order of assignment. Electronic, magnetic or mechanical recording devices shall be approved by the Office of State Courts Administrator prior to their utilization by any magistrate or probate judge. (H.B. 1317, 1098, 78th Missouri General Assembly, 1976)

Constitutional Amendment SJR24, passed by the Missouri voters in 1976, specified that only one of these alternative systems be used by the Associate Circuit Judge, stating:

> Until otherwise determined by law, any cause heard and decided by an associate circuit judge shall utilize electronic, magnetic or mechanical recording devices for the purpose of preserving the record. The Office of the State Courts Administrator shall approve any electronic, magnetic or mechanical recording device prior to utilization by any associate circuit judge. (Mo. Constitution SJR24, 1976)

Statement of the Problem

The legislative mandate of House Bills 1317 and 1098 and the Constitutional charge of SJR24 which required the Office of the State Courts Administrator to approve electronic, magnetic or mechanical recording devices made it imperative that some means of determining accurate and efficient recording systems be developed. Review of the history of magnetic court recording use, evaluation, and specifications revealed inconclusive findings. A survey of the available court recording equipment also showed many new features which had not been tested or included in other states' specifications.

It was determined that a new study be conducted to define accurate and efficient magnetic recording devices for use in preparing the verbatim record in the Missouri Associate Circuit Courts. Based on the review of literature, the study was limited to four-channel audio recording systems.

This study was initiated on January 3, 1976, under the direction of the Office of the State Courts Administrator of Missouri, and funded by a grant from the Missouri Council of Criminal Justice. To provide direction for this study, a Magistrate-Probate Court Recording Device Evaluation committee was formed, composed of:

Judge Patrick Horner, Fulton; Judge P. F. Palumbo, St. Louis, Judge Louis Davis, Grandview; Judge William E. Turnage, Kansas City. The committee, at its first meeting, recommended in a memorandum to the court, that the pilot courts of the study be authorized to use recording equipment which is to be evaluated. The committee also permitted the continued use of sound recording in those courts where some recording had been utilized in the past, provided that such devices had the capability of providing a record from which the typewritten transcript could be made. The Office of the State Courts Administrator, in a memorandum to all Circuit and Magistrate Judges urged the courts to refrain from expending any money on recording equipment until specifications were developed by the study reported here.

The overall purpose of this study was to evaluate alternative recording systems in order to develop specifications for effective electronic magnetic recording systems for the Missouri Associate Circuit Courts. Research activity necessary to this goal was: (1) study of the evaluations of court recording systems conducted by other courts; (2) study of the specifications adopted by other states for magnetic recording systems; (3) study of the available equipment for magnetic court recording; (4) testing of selected magnetic court recording systems to determine efficiency and effectiveness.

Research Questions and Hypotheses

This investigation attempted to answer the following research questions:

1. Does equipment which meets selection specifications perform significantly poorer or better in operating ease, recording accuracy and transcription ease?
2. When courts are asked to rate their preferences for recording systems, will the ratings agree between Groups I, II and the transcription group.

Research question one (1) required the formulation and testing of the following hypotheses:

H1 = There are no statistically significant differences among mean scores for operating ease in recording Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

H2 = There are no statistically significant differences among mean recording accuracy scores for Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

H3 = There are no statistically significant differences among mean scores for operating ease in Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

H4 = There are no statistically significant differences among mean recording accuracy scores for Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

H5 = There are no statistically significant differences among mean transcription scores for all systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam).

Research question two (2) did not lend itself to hypothesis formulation. The most appropriate strategy was to ask operators of the systems tested to rate their preferences for the systems at the conclusion of all tests. These ratings were then compared between groups I, II and the transcription group to determine if similarities or differences existed.

Definition of Terms

The following terms are defined as they were used in the study.

Balanced Line Microphones - Microphones which include a third cable for grounding the microphone to the recording machine.

Cardiod Microphones - Microphones which have directional sound sensitivity.

Court - The court in this experiment includes the physical environment, the acoustics, and the personnel.

Court Preference - Rating of preference of recording systems 1-5, best to worst, by the courts.

Court Recording/Transcribing System - A four channel recorder and auxiliary equipment of microphones, headset, microphone stands, foot pedal and cables.

Distorted Recording - Sounds which when played through the system's headphones, are audibly altered to such an extent they cannot be understood or identified.

Extraneous Noise - Sound which when played through the system's headphones distracts from the recording but does not necessarily render the recording unintelligible; extraneous noise may function as a nuisance to transcriber and contribute to error.

Indexing Systems - A numerical display of location of recording.

Low Impedance Microphones - Microphones with a nominal impedance of less than 600 Ohms.

Monitoring Recording - The ability to insure that recording is taking place while recording by listening to what has previously been recorded on the tape through headphones or by viewing visual indicators of presence of recording on the tape.

Operating Ease - Numerical mean scores of the Likert-based ease of operation questionnaires completed by the recording system operators.

Over-record Inhibitor (Signal Sensor) - A feature which stops the recording when sensing that recording is already present on the tape.

Recording Accuracy Scores - Numerical mean scores of distorted recording, extraneous noise and subaudible recording (definition to follow).

Stenotype Recording - A system of machine shorthand used by most court reporters. The record is reproduced by striking a combination of letters onto a paper tape. The reporter may translate his own notes and type the transcript or dictate his notes for another typist to transcribe.

Subaudible Recording - Sound which, when played back through the system's headphones, can be heard but not understood.

Transcription Ease - Numerical mean scores of the Likert-based ease of transcription questionnaire completed by the transcribers.

Transcription Preference - Ratings of preference of transcribing systems 1-5, best to worst, by the transcribers.

Assumptions of the Study

This study made the following assumptions:

1. That the sample of courts chosen for testing were representative of most courts in Missouri.

2. That the time given each court to test each machine was of sufficient length for an effect to be observed.

3. That the time given each court to test each machine was of sufficient length to insure accurate measurement of an effect.

4. That the operators evaluating the systems performed the recording to the best of their abilities.

5. That the operators measuring the systems were impartial.

6. That the instruments used to measure accuracy of recording and ease of operation were reliable and valid.

Limitations of the Study

The design of this study may have resulted in the following limitations:

1. The study was conducted over a five-month period; different weather conditions may have affected the operation of the recording systems.

2. Transportation of the systems from court to court may have affected operation.

3. The selection of courts on an at-hand basis may limit the generalizability of the results to other courts.

4. The short term of the transcribing test may not have given the transcribers enough time to truly test the reliability of the systems.

CHAPTER II

RELATED LITERATURE

The purpose of this research is to evaluate magnetic court recording equipment in order to develop specifications for accurate court recording and transcribing systems for the Missouri Associate Circuit Courts. Important in providing background knowledge to determine variables for such a study is the review of literature in the fields of: (1) Magnetic Recording, (2) Acoustics, and (3) Magnetic Recording in the Courts.

Magnetic Recording

Magnetic recording was developed in the late 1890's by a Danish electrical engineer, Valdemar Poulsen. The first magnetic recorder used a flat steel disk or steel ribbon. "Poulsen had devised it originally as a means of making more efficient use of telephone circuitry . . ." (Blacker, 1975, p. 32). Nonmagnetic oxide on tape was first used for recording in 1930 by German engineers who used a plastic backing. "Magnetic recording lay essentially dormant until the Second World War, during which time it was employed by the German Forces"

(Jorgensen, 1970, p. 6). Magnetic recorders were captured from the Germans in the Second World War and brought to the United States where the technology developed rapidly. The first American recorder was delivered to the American Broadcasting Company in 1948 by the Ampex Corporation. Since that time recorders have developed from systems designed for professional recording use to commercial and home recording machines.

Jorgensen, in his book, Handbook of Magnetic Recording, explains the concept of magnetic recording in layman's terms:

> The principles of magnetic recording are based on the physics of magnetism, a phenomenon which relates to certain metallic materials. Magnetization of materials occurs when they are placed in a magnetic field. If the material is in the group of so-called "hard" magnetic materials, it will hold its magnetization after it has been moved away from the exciting source. . . .
>
> An incoming sound wave is picked up by a microphone and amplified into a recording current . . . which flows through the winding in the record head. The record head has a "soft" magnetic core (so magnetization is not retained) with an air gap in front. The current, . . . produces magnetic field lines that diverge from the air gap and penetrate the tape, moving past the record head from the supply reel. The tape itself is a plastic ribbon coated with a "hard" magnetic material which maintains its magnetization after it has passed the gap in the record head.
>
> The tape passes over the playback head which, like the record head, is a ring core with a front gap. The magnetic field lines (flux) from the recorded tape permeate the core and produce an induced voltage across the winding. This voltage, after suitable amplification reproduces the original sound through a speaker. (Jorgensen, 1970, p. 9)

The basic components of a magnetic recording system were found to be: (1) Recorder and tape, (2) Microphones.

Recorder and Tape

> A magnetic tape recorder is a device for the recording and playback of sound, music or data information. It is essentially constructed in two sections:
>
> 1. A tape deck (or transport) that moves the tape past the recording and playback heads. It has the necessary controls for starting and stopping the tape motion.
>
> 2. An electronic section that contains the recording and playback amplifiers. This includes an erase/bias oscillator section and power supplies. Most recorders are provided with level indicators to assure proper recording levels. (Jorgensen, 1970, p. 26)

Variables found in tape recorder transports can be divided into: (1) tape type, (2) tape speed, (3) tape handling, (4) tape indexing, and (5) electronics.

Tape Type

Studies showed magnetic materials in many forms can be used to preserve sound.

> Disks, coated or impregnated with magnetic material and recorded in parallel or spiral tracks, are used in such applications as office dictating machines and electronic computers. (Encyclopedia Britannica, 1973, p. 682)

Many of the early court recording systems used magnetic disks. IBM still uses magnetic disks for their office dictating equipment. Two more popular types of tape are the reel to reel and cassette. The reel to reel tape is

produced in 1", 1/2" and 1/4" sizes.

> Audio tapes are one-fourth-inch wide tapes used by the sound recording industry, broadcast stations, and in homes. (One-half and one-inch wide tapes are also used in certain sound recording studios, where several microphone outputs are recorded on individual tracks for later mixing.) The one-fourth-inch tapes are typically wound on 7-inch diameter reels or 10½-inch reels for professional use. The 7-inch reels contain 1200 feet (one and one-half mil base thickness), 1800 feet (1 mil), or 2400 feet (one-half mil tensilized polyester), and are generally called out as standard, long-play, and extra long-play (this call-out differs from manufacturer to manufacturer). The 1800-foot version seems to be the most popular, considering economy and playing time. (Jorgensen, 1970, p. 117)

The cassette was introduced by Phillips Company in the late 1960's. "The plastic cassette contains two bobbins, one of which is wound with 1/8" tape, the end leading past an opening in the box to the second bobbin" (Crawford, 1974, p. 22). The convenience of the cassette is that no tape is threaded as in the reel to reel system. Cassettes come in different lengths stated in minutes, from 15 minutes to 120 minutes. The actual length of recording is determined by the speed of the transport and the type of electronics.

Study of literature revealed that tape varies as to the type of material used to magnetically capture the sound which has been transformed into electrical impulses.

> The magnetic material most often used in coating tape is red iron oxide. Black iron oxide has also been used; it produced a higher signal strength, but is more difficult to erase. Chromium oxide, CrO_2, and cobalt-doped iron oxide are advantageous in some applications.

> The magnetic powder is thoroughly mixed with a binder, the nature of the latter depending partly on the base material to which it will be applied. The polymeric vinyl chlorides, vinyl acetate, cellulose acetate and ethyl cellulose are commonly used. The solvent employed must not attack the base material or cause adjacent layers of tape to stick to each other when the tape is tightly wound and stored at relatively high temperatures. The object is to obtain a very thin but dense layer of iron oxide on the tape in a very uniform distribution. It must adhere tightly to the base tape, but not to an adjacent layer; it must be flexible, and preferably its characteristics should not change appreciably over many thousands of usages or many years of storage. (Encyclopedia Britannica, 1973, p. 681)

> The quality of tapes on the audio market varies widely and it is generally recommended that the user buy brand-name tapes. The so-called white-box tapes may have been rejected by computer tape manufacturers; these tapes are likely to be high in abrasion and, in addition, quite likely to be under a strain resulting from a poor slitting process.
>
> Variations in the frequency response of recognized tapes are minor, but may require different bias settings (and possibly equalization). It is, therefore, a good rule to stay with a given brand tape once it has been selected. There are several tests that can be made in the selection of a tape. These tests are visual and if a reel of tape does not pass them, it will most likely perform poorly on a tape transport. (Jorgensen, 1970, p. 117)

Test for Slitting and Winding

> Hold the tape reel against a bright light source, like a window. If the light shines through evenly, the tape is proper. Spotty dark areas indicate an uneven slit. Also, feel the tape pack; it should feel smooth. (Jorgensen, 1970, p. 118)

In the present study it was decided that use of tapes be limited to those recommended by the manufacturer of the recorder.

Tape Speed

Transports of some recorders provided the ability to select different speeds of recording and playback. Many machines were designed to record and play back at only one speed. A tape recorded at one speed must be played back at the same speed to retain quality. New features found on a few recorders, such as speech compression, allow faster playback but retain a high degree of sound quality. Following is a published chart of normal playback speeds for normal tape lengths showing time of recording (Jorgensen, 1970, p. 119).

Length Feet	Speed		
	3-3/4 ips	1-7/8 ips	1-5/16 ips
3600	3:12	6:24	12:48
2400	2:7	4:15	8:30
1800	1:36	3:12	6:24
1200	1:14	2:7	4:15
	Time of Recorder		

Tape Handling

Most tape transports provide the common handling controls of Record, Playback, Fast Forward, and Rewind. Variables were found in the ease with which transports

performed these functions. Some proved to have easy-to-operate controls with fast response, others showed harder-to-operate controls and slower responses. Following is a published explanation of the tape handling components of the transport and its variables.

> The tape transport mechanism consists of the takeup and payoff reels and the capstan drive. The capstan is connected to a large rotational inertia to provide a relatively constant rotational velocity. A rubber pressure roller presses the tape against the capstan to insure good contact of the tape with the capstan. The takeup reel mechanism produces a relatively constant tension in the takeup tape. Some sort of braking on the payoff reel leads to a relatively constant tension in the payoff tape.
>
> In professional and high quality magnetic tape machines separate motors are provided for the capstan, takeup reel, and payoff reel drives. . . . The capstan drive consists of a two-speed synchronous motor with the capstan as an extension of the shaft. In recording or playing the tape the takeup reel motor supplies the appropriate torque to insure relatively constant tension in the takeup tape. The payoff reel motor supplies a braking torque to insure relatively constant tension in the payoff tape. In rewinding, the pressure roller does not engage the tape, and the functions of the takeup and payoff motors are reversed.
>
> In the lower-cost magnetic tape machines a single motor is used to supply the rotational functions of the capstan, takeup, and payoff reel. There are innumerable designs for accomplishing the required performance. (Olson, 1972, pp. 148-149)

Some transports have special features such as automatic stop at the end of the tape or with a broken tape. Automatic search to the selected index number is a new feature found on a few transports.

Indexing

Study of literature of magnetic rewinding showed many tape transports to have indexing systems. Indexing systems allowed the notation of the location of a particular recording and the ability to return to that position on the tape. Variables in indexing systems proved to be in the visibility of the indexes and the accuracy of the indexes. Indexing counters which were powered by the capstan were found to be more accurate than counters which are powered by the reel holders. Newer developments in indexing provided lighted digital display.

Electronics

The electronics of the tape recorder was defined to include the components which transform the electrical energy sent by the microphones into magnetic signals on the tape. Electronic controls provided features with which to alter these signals and operate playback energy. Following is a review of the literature defining electronic features which differ on most tape recorders.

The beginning electronic component which was found to affect the sound of the recording is the recording volume control. Many recording volume controls may only be manually set. Manual volume control requires the operator to use a record level indicator.

> Magnetic recorders are generally provided with a level indicator to warn the operator of excessive recording levels. In its infancy, the magnetic recorder was provided with a VU meter, which stands for volume meter, a leftover from the early broadcast industry. This instrument is very inadequate for informing the engineer about the proper recording level, since distortion may very well take place at instantaneous peaks of the signal to be recorded, in turn, causing intermodulation distortion. Peaks are much more readily detected by peak-reading indicators, which may be a moving-coil instrument with a suitable amplifier, a "magic" eye instrument, or neon lamp. (Jorgensen, 1970, p. 93)

Automatic level controls are included on some tape recorders.

> The autorecord or automatic gain is a device that enables you to record without using or adjusting the normal record volume control. Since the normal control can be set too high or too low resulting in a distorted or hissing recording, the autorecord is ideal for the tape-machine user who simply requires some sound retained and is not interested in any dramatic or artistic colouring of the recording. . . .
>
> . . .it will adjust itself to record the more distant speaker immediately after the speaker closest to the microphone. (Crawford, 1975, p. 18)

Some recorders have limiters or combined limiters and automatic level controls.

> A limiter is an electronic circuit that keeps the levels of a signal down to a prescribed limit. This automatic level control device is particularly useful in that it can prevent a recording system from overloading and ruining the tape with distortion. The limiter is often combined with an automatic gain device to amplify low-level signals, and the two circuits together are known as a Compressor. (Crawford, 1975, p. 53)

The final electronic control which affects the recording ability of the recorder is the Head.

> The magnetic heads that erase, record and replay the tape are small electro-magnets. An electro-magnet consists of a core of iron on which is wound a coil of wire. When an

> electric current is passed through the coil, a magnetic field is set up around it, and the core behaves like a magnet. Magnetic heads are designed in a ring shape with a tiny gap in their core across which the magnetic fields they produce have to jump. This gap on the head is positioned so that the tape passes across it, bridging the non-magnetic gap and in the process becoming magnetised itself. In this way the tape-recorder erases and records on magnetic tape.
>
> In the case of the replay head the process is reversed. A magnetised tape (that is a tape that has already been recorded) is passed over the gap of the replay head and in doing so feeds its magnetic field in the coil of the head. When a magnetic field is moved into a coil of wire it induces an electric current in the wire, and it is this induced signal that is amplified, fed to a loudspeaker and reproduces whatever was recorded on the tape. (Crawford, 1975, pp. 42-43)

- Heads control the amount of recording tracks on the tape: monoral heads putting one separate electronic signal of the sound on the tape; stereo putting two; four channel putting four separate signals on the tape (one for each microphone in use).

> The sound head unit contains three distinct parts: First the erase head, which serves to erase from the tape the previous recordings. . . . Next comes the record head, which converts the electrical signals into a magnetic pattern on the tape. . . . The final head in the line is the playback head whose function is to reconvert the magnetic recording into electrical signals and thus back to the original sound. The replay head not only serves to play back the tape . . . but also makes possible monitoring the tape at the time of recording. (Staab, 1968, p. 19)

> The early recorders used only single track (monoral) heads for both record and playback. Later advances in technology allowed consumer use of three head (erase - record - playback) four channel recorders. (Jorgensen, 1970, p. 23)

Microphones

The microphone was shown in the literature to be the component of the recording system which first transforms sound into electrical energy. Microphones were categorized by design and pickup pattern. Two common microphone designs were the Dynamic and the Condensor microphones.

> Superior quality is obtained by using a dynamic microphone, which may be a moving-coil type or a ribbon microphone. The moving-coil microphone is constructed in a manner quite similar to that of a loudspeaker. When a sound wave hits the diaphragm the coil moves back and forth in a magnetic field and generates a voltage in the coil. In the ribbon (velocity) microphone, a thin corrugated metal ribbon is suspended in a magnetic field and a voltage is generated when it vibrates back and forth under the influence of sound waves. Dynamic microphones are more expensive than crystal microphones, but the cost is fully justified in the making of quality recordings. . . . obviously smoother than the crystal microphone. (Jorgensen, 1970, p. 124)

A condensor microphone requires an electrical charge to sensitize it to sound. This power is usually in the form of a small battery housed in the microphone itself.

Microphones also differ in pickup pattern. Omni-directional microphones are designed to be sensitive to sound from all directions. Uni-directional microphones pick up sound from a limited area. Microphone pickup pattern selection was found to be affected greatly by the acoustics of the recording environment.

Acoustics

Review of the literature showed acoustics to have a potential effect upon the quality of the recording. Jorgensen stated:

> The quality of a recording depends heavily on room acoustics, since the microphone will pick up the direct sound from the sound source as well as the indirect sound coming from reflections off the walls in the room (reverberation). The contribution from the indirect sound plays a major role in the recorded sound quality since it "colors" the sound. A recording made in a well-damped room (carpets, upholstered furniture, drapes, etc.), where the reverberation is small, will sound dry and unnatural. A recording made in an empty room with hard walls, on the other hand, will contain a large amount of reverberation, which in speech will mask the intelligence and in music will contribute heavy echo effects.
>
> The ratio between the direct sound and the indirect sound can be varied by changing the distance between the sound source (for instance, a speaker) and the microphone. It will be necessary to experiment to find the best microphone position, where the ratio between the direct and indirect sound is the best possible and the recording sounds most natural. (Jorgensen, 1970, p. 133)

Crawford agreed, stating:

> The acoustic properties of a room in which a sound is recorded will affect how it actually sounds. Wallpapered or painted walls will directly reflect any sound-waves hitting them and the waves arriving at the microphone in a "hard wall" room will consist of the original sound mixed with these reflections which arrive slightly later. This results in an echoey effect called reverberation. Reverberation can become intolerable in a large hall with plenty of hard surfaces and no soft furnishings to absorb the many reflections. Try giving a speech in a canteen!
>
> Reverberation is controlled by changing the surfaces in a room to be used for recording, and by introducing barriers to the reflected sound-waves. The first necessity in the room is a carpet, the bigger and thicker the better. This will eliminate reflections from the floor, and absorb waves reflected downwards by the ceiling. Tapestry or curtaining over the walls will stop lateral sound-waves from bouncing around the room, and soft furnishings, even human bodies, will absorb the sound-waves. (Crawford, 1970, p. 15)

Review of this literature on magnetic recording and acoustics emphasized that magnetic recording should be a systems approach with defined variables. These variables should all be investigated thoroughly if accurate recording is to take place.

Magnetic Recording in the Courts

Literature describing magnetic recording in the courts is somewhat limited. Legal and judicial journal articles on the subject have not been published in recent years. However, older journal articles do give a history of the early evaluation of Magnetic Court Reporting. The researcher was also fortunate to acquire reports with which to review more recent tests of Magnetic Court Recording. A study of this literature provides a historical perspective of Magnetic Court Recording and a definition of variables which might require further evaluation before a reliable system of magnetic court recording could be instituted for the Missouri Magistrate Courts.

One of the first installations of Magnetic Court Recording equipment was completed in the District Courts of Puerto Rico in 1952. Forty-nine recorders and forty-nine transcribers were purchased at $800 per unit. District courts of this jurisdiction did not formerly

make any record of proceedings. The system was to be operated by the judge and the sound recording was to be the basis of appeal from the district courts to the superior and supreme courts of Puerto Rico (Rodebaugh, 1953, p. 288).

In the same year, the New York Board of Estimate installed a magnetic tape recording system with thirteen microphones.

> The new recording system, which will supplement and perhaps later replace the present method of recording the board's proceedings with the aid of stenographers using stenotype machines, is being installed at a cost of $3,639. . . . Resort to the tape recorder device was made necessary, it was explained, because of increasing difficulty in obtaining the services of qualified high speed operators of the stenotype machines now in use. (Rodebaugh, 1953, p. 289)

Rodebaugh, Chairman of the United States Conference of Court Reporters, found this event very disturbing for it was one of the first instances in which magnetic systems were installed with plans to replace the Court Reporters.

The same article reported one of the first large scale evaluations of magnetic recording systems. The U.S. Navy Office of the Judge Advocate General tested the quality of recording from three different manufacturers. The reason stated for the test was the "perennial problems . . . of obtaining qualified Court Reporters." The report of that test concluded, "One of the principal limitations on any mechanical reporting systems is that the

dictating machine will record clearly only one spoken voice at a time." The evaluators, recognizing that a two-at-one-time speaking situation may occur, stated, "In conclusion it does not appear that the 'open mike' recording system is completely satisfactory or a substitute for a well-trained and experienced court reporter. . . ."

In September of 1952, the Judicial Conference of the United States reported after a performance test of audio recording equipment:

> The impression produced on the committee and personnel of the court was favorable but experimentation for further improvement in equipment and technique was going on and progress was expected within the next year. The conference authorized the committee to continue its study. (Rodebaugh, 1953, p. 289)

This was the beginning of a long-term evaluation of magnetic court reporting in the United States District Courts. The study continued in 1958 with the cooperation of manufacturers of the recording equipment.

In 1959 the Judicial Conference of the United States, Administrative Office of the United States Courts Subcommittee on Court Reporting made the following recommendations:

> . . . "that the Administrative Office be instructed, wherever possible and agreeable to the Judges concerned, to supply electronic recording systems for use in the United States District Court whenever a vacancy occurs in the office of the existing reporter," and that recommendation was adopted by the Judicial Conference of the United States in September of that year. (Rodebaugh, 1961, p. 1185)

The conclusion of this Evaluation of Magnetic Court Reporting equipment was published in a report entitled The Court Reporting System in the United States Courts 1960. The report was both a general survey and a consideration of electrical recording.

> It stated that among the attorneys interviewed, the large majority were favorably inclined to the use of sound recordings as a means of promoting justice by securing a more accurate record of court proceedings, and that a substantial number were very emphatic in their belief that sound recording should be relied upon in place of shorthand notes. The report concluded that experience to date indicates reliance upon high-fidelity recordings for the record of proceedings in the United States district courts is feasible and that such recordings would provide a much more accurate and complete record. The authors expressed their belief that "recording equipment should and will eventually be used in all United States district courts" instead of shorthand reporters. (Rodebaugh, 1961, p. 1186)

Connecticut in 1959 began a reorganization of the state courts. Forty new judges were appointed to courts which had no means of supplying a record of proceedings. A system of recording had to be instituted by January 1, 1961.

> Believing that a sufficient number of court reporters would be difficult or impossible to obtain, the judges decided to investigate electrical recording. In the spring of 1960 several test sessions were recorded by shorthand reporters and also by a representative group of electrical recording machines. As a result of the tests the circuit court judges decided to dispense with consideration of electrical recording and to find and appoint competent shorthand reporters. This was done. (Rodebaugh, 1961, p. 1187)

> The Chief Justice of the Supreme Court has stated that there were three reasons for adopting electronic equipment: first, the tape record is the best means for determining

> what is said; second, sound recording meant a tremendous financial saving by eliminating salaries of court reporters; and third, conventional methods were impractical for Alaska because of the chronic shortage of court reporters.
>
> When Alaska became a state in 1959 the Supreme Court adopted a rule that made electronic recording systems the exclusive method of preserving the record of all courts. (Reynolds, 1953, p. 289)

In 1961 Warren Olney III, Director of the Administrative Office of the United States Courts, published the report "Report on Electronic Sound Recording in the Trial Courts of the State of Alaska." The report was based on a visit to the Alaska Courts in 1960. The conclusions of his report follow:

> That comparison of electronic sound recordings in Alaska with conventional shorthand reporting produces a more accurate and complete record, a record which need not be transcribed to be useful. It reduces delay in transcription, and is less costly. (Rodebaugh, 1961, p. 1186)

A test was made of the equipment used in the Alaska courts by the District of Columbia Circuit Courts in 1961. The three week trial of two tape recording systems compared accuracy, speed and economy with the present court reporting personnel (Rodebaugh, 1961, 1168).

The District of Columbia Report concluded that:

> From the comprehensive experience gained from the actual use of the (manufacturer's) equipment, which this Committee found to be the most advanced and suitable available, the Committee feels and therefore recommends that such equipment, at present, is not an adaptable or feasible substitute for the present system of verbatim reporting of proceedings in the United States District Court by skilled individual court reporters. (Rodebaugh, 1961)

Problems with the magnetic recording equipment were noted:

> The machine possesses too great a sensitivity in that it records not only the spoken word but coughing, footsteps, rustling of paper, and other extraneous noises. Yet its sensitivity is limited by the placement of microphones. Speech which takes place beyond the perimeter of sensitivity of the microphone is inaudible. In other instances involving proceedings with multiple parties or multiple counsel, it is difficult to distinguish from one sound tape precisely what has occurred. The machine, therefore, lacks the very important human function of discriminating intelligently as to what has transpired. (Rodebaugh, 1961)

In 1970 the New York Courts conducted a comparative evaluation of court recording equipment and court reporters (Rodebaugh, 1972, p. 71). Simultaneously recordings were made by the magnetic recorders and the court reporters. Transcripts of the three days of recordings were compared for accuracy and speed of recording. To measure speed of recording, a full transcript of a day's trial was to be turned in by 7:00 p.m. that day.

Two types of magnetic recording systems were tested, a six-channel magnetic tape Dictaphone machine and a single-channel Edison Voicewriter disc machine.

Results showed that the court reporter significantly outperformed the recording machines in mistakes in the transcript. However, the report states:

> Although the two recording machines were not in direct competition with one another, the statistics showed that the six-channel machine fared better than the single-channel machine, although it still could not equal the accuracy of the court reporters. However, the difference might have been partly attributable to the acoustics in the various courtrooms. (Rodebaugh, 1972, p. 72)

Transcript preparation time statistics were inconclusive in the tests because dictaphone failed to list time taken in preparation.

Problems experienced by machines were noted in this article:

> * Because of poor courtroom acoustics and the sensitivity of the microphones, extraneous noises were picked up and at times tended to extinguish what was being said.
>
> * Non-verbal actions of participants (such as a shake of the head, pointing, and so forth) were lost in the machine transcripts because their transcribers were not present in the courtroom to observe.
>
> * The machine monitors on occasion had difficulty playing back prior testimony in the courtroom. At one point in the Supreme Court test, when the tape playback could not be understood, the monitor suggested that the Court ask the reporter to read the prior testimony, which was done. (Rodebaugh, 1972, p. 73)

The Report of the Study concluded that the transcripts of court reporters were superior to the recording machines (Rodebaugh, 1972, p. 74).

An evaluation of magnetic recording which was very similar to the New York Study was completed in the Los Angeles Superior Courts in 1972 (Superior Court, County of Los Angeles, 1972). This evaluation also included the comparison of transcripts from simultaneous recordings of magnetic recording systems and court reporters. The following magnetic recording equipment was parallel tested with the official reporters: 1) the Dictaphone court memory system, a six-channel court

recorder, 2) the Edison Voicewriter continuous message recorder, a magnetic disk recorder. The study continued for fifteen days and a random sample of 418 pages of transcript was compared. Following is a statement of the results of the transcript comparisons:

> Based upon the major error factor alone, it is evident that the official reporters, in all but two (2) test proceedings, performed with a higher degree of accuracy than the parallel-tested reporting/recording systems. (Superior Court, County of Los Angeles, 1972, p. 33)

The following statement was made during the description of the study:

> The results of these tests indicate that a combination of various systems, both stenographic reporter input and electronic recording system input may provide the best operational and most cost-effective means of recording and transcribing Los Angeles Superior Court Proceedings. (Superior Court, County of Los Angeles, 1972, pp. 38-39)

The conclusive findings of the Los Angeles study and the advent of new magnetic recording equipment prompted another comparison of court reporters and magnetic court recording. This study was conducted in the Sacramento, California District Courts in 1973 (A Study of Court Reporting, 1973). This study also was a parallel test of accuracy and speed of transcripts produced by the subjects.

The following magnetic recording systems were evaluated: (1) AKAI 280 DSS, a four-channel recording system; (2) Dictaphone 4000, an eight-channel recording system (not tested in Los Angeles); (3) Stancil-Hoffman, a

six-channel recorder; (4) Baird Atomic MR-600-8, an eight-channel recorder. During the test only one recording device was tested in the courtroom at a time (A Study of Court Reporting, 1973, p. 21).

The results of the study were evaluated by a consulting team using a t-test and an F-test for statistical analysis of variance. Following are the tables of the results:

TOTAL ERRORS BY PROJECT OR COURT REPORTER METHOD*

	Mean Errors Per Page	Standard Deviation	N	t-test Value	Confidence Level
Project Method	5.8676	5.5045	370	12.0065	99.95%
Court Reporter Method	16.7270	16.5040	370		

COMPARISON BY TYPE OF TRANSCRIBING MACHINE*

	Mean Errors Per Page	Standard Deviation	N	F-ratio	Confidence Level
Akai	7.4762	6.2700	210		
Scullo-Metro	4.3333	3.2867	60		
Stancil-Hoffman	3.0750	2.9211	40		
Baird-Atomic	3.6333	3.4394	69	15.9972 (3 df)	99.9%

*A Study of Court Reporting, 1973, p. 6.

The results of the evaluation showed that the audio method of developing court transcripts resulted in significantly less errors than the stenotype method (A Study of Court Reporting, 1973, p. 6). No statistical comparison was completed to compare the performance of the different recording machines.

In November of 1973 the District Courts of Massachusetts evaluated alternative methods of providing verbatim records in their newly organized courts. The test consisted of demonstrations of alternative systems in the District Court of East Norfolk and other courts with poor acoustics. The committee also reviewed the taping of transcripts from those recordings (Report on the Preservation of Testimony on Proceedings in the District Courts of Massachusetts, 1973, pp. 13-14).

The study concluded that multi-track magnetic recording was the most efficient means of preserving the records in the District Courts. The following specifications were developed for selection of equipment:

REPORT ON PRESERVATION OF TESTIMONY IN PROCEEDINGS IN THE MAGISTRATE COURTS OF MASSACHUSETTS

Court Recorder Specifications

* Capable of using standard reels of tape, providing at least three hours of continuous recording at a standard speed and able to be rapidly copied to cassette form.

* Multi-track.

- Sufficiently sensitive and of sufficient fidelity to record all testimony, questions, rulings and other proceedings in the courtroom.

- Easy to operate by persons with the training and abilities of existing courtroom personnel.

- Reliable, with minimum maintenance requirements.

- Not capable of recording over already existing testimony.

- Equipped with automatic gain control.

- Equipped with visual and aural monitoring capability.

- Equipped with delayed monitoring.

- Portable, but capable of being locked and secured to prevent tampering.

- Equipped with a dependable, easily readable index counter or other device to assist in place finding on the tape.

- Usable with short range, omni-directional microphones, which can be adapted for mounted or lavalier use, and possessing individual spring-loaded shut off switches to preserve confidentiality.

- Equipped with an internal amplifier and speaker.

The researcher was able to acquire other state specifications of magnetic court recording equipment for review. These specifications are listed here:

THE JUDICIAL COUNCIL OF THE STATE OF CALIFORNIA

Specifications for Electronic Recording Equipment

The following specifications for approved electronic recording equipment for use in recording courtroom proceedings when no court reporter is available are adopted by the Judicial Council pursuant to Government Code Section 72194.5, added by Chapter 665, Statutes of 1975:

1. Electronic recording devices and appurtenant equipment which conform substantially to the following specifications are approved for courtroom use:

   (a) The device is capable of simultaneously recording at least four separate channels or "tracks", each of which has a separate playback volume control so that any one channel separately or any combination of channels may be played back.
   (b) The device has a digital counter or comparable means of logging and locating the place on a reel where specific proceedings took place.
   (c) Earphones are provided for monitoring the recorded signal.
   (d) The signal going to the earphones comes from a separate playback head, so that the monitor will hear what has actually been recorded on the tape.
   (e) The device is capable of recording at least two hours without interruption. This requirement may be satisfied by a device which automatically switches from one recording back to another at the completion of a reel of tape less than two hours in duration.
   (f) A separate visual indicator of signal level is provided for each recording channel.
   (g) The appurtenant equipment includes at least four microphones, which should include one omnidirectional microphone placed at the witness stand and unidirectional microphones at the bench, and each counsel table.
   (h) A loudspeaker is provided for courtroom playback.

2. The following features are recommended, but not required:

   (a) Recording level control should be automatic rather than manual.
   (b) The device should be equipped to prevent recording over a previously recorded segment of tape.
   (c) The device should give a warning signal at the end of a reel of tape.

3. The Administrative Director of the Courts is authorized to approve, on behalf of the Council, any electronic recording devices and appurtenant equipment acquired prior to September 1, 1975, regularly used for the recording of court proceedings and found by the court to produce satisfactory recordings of the proceedings.

NEW JERSEY
REGULATIONS APPLICABLE TO SOUND RECORDING
IN THE MUNICIPAL COURTS
REQUIREMENTS FOR THE TYPE, INSTALLATION AND OPERATION
OF SOUND RECORDING EQUIPMENT

TYPE

The recorder shall meet the following specifications:

1. Be capable of courtroom or conference recording.

2. May be of the single-channel (track) or of the multichannel (track) variety.

3. Have provision for at least four microphones.

4. Provide for playback over integral speaker.

5. Provision for transcription through the recording unit or through a separate transcribing unit purchased as part of the package. (Transcribing means a foot pedal operation that has back space provision as well as stop-start, and headset for listening.)

6. Where court is in session more than 15 hours or 3 days a week, a separate transcribing unit shall be provided.

7. Be equipped for indexing the recording, so that a log sheet can be maintained of the proceedings.

8. Provide for earphones for the operator to monitor the proceedings while the recording is taking place.

9. Provide a minimum of 3 hours of continuous recording without having to stop proceedings to change the recording medium.

10. Be capable of producing a recording clear through to be accurately and completely transcribed.

SPECIFICATIONS LIST FOR THE
NEBRASKA TAPE RECORDER SYSTEM

DESCRIPTION:

Courtroom Multi-Channel Tape Recorders.

SPECIFICATIONS:

1. Recorders must have a minimum of four (4) separate channels capable of recording a signal as well as transcribing from any one channel or all at once.

2. An instantaneous monitoring capability for the operator, separate from the channel requirements listed in (1) above.

3. Recording and transcribing from the same machine.

4. Light weight.

5. Able to be moved around from county to county easily.

6. Fast forward and reverse switch.

7. Has remote foot pedal control for transcribing.

8. Four-digit tape counter.

9. Handle various size tapes.

10. Volume indicator (VU Meter).

11. Transcriber can select one channel or hear all channels at once (MIXER)

12. Multiple Speed Contro. Off-set by Hysteresis Synchronous Torque Motors.

13. Volume Control for each channel.

14. Signal indicator, (if tape has previous voice on machine it will not record over signal).

15. Uses magnetic tapes capable of being erased and reused.

16. Speed Control for transcribing.

Summary

The foregoing review reveals that the history of the acceptance of the system of magnetic recording in the courts follows closely the refinement of recording technology. Most of the early evaluations of single channel magnetic recording showed mixed results. The statistically controlled Sacramento (1973) study of multi-channel recorders greatly substantiated the argument that magnetic recording is a feasible alternative to stenotype recording. Following this contention, many states initiated multi-channel magnetic recording in the courts through developed specifications. Characteristics of magnetic recording systems which operated most effectively were only briefly mentioned in the literature. The emphasis was in comparing magnetic recording to stenotype.

CHAPTER III

PROCEDURES AND STATISTICAL DESIGN

The purpose of this study was to evaluate electronic magnetic court recording systems in order to develop specifications for the Missouri Associate Circuit Courts. The review of related literature showed that no current study had been designed to develop these specifications and that new untested equipment was then available.

The discrepancies among other states' specifications, untested features of new court recording equipment and different acoustical and staffing characteristics of courtrooms pointed out and emphasized the need for an operational test of available recording equipment in many types of Missouri Courts.

To accomplish the purpose of developing specifications for electronic and magnetic court recording systems for the Missouri Associate Circuit Courts, appropriate court recording systems needed to be selected, courts needed to be chosen for testing, evaluation instruments designed and data collected on the performances of the systems.

A six-month study was designed to gather data on the variables of court recording systems. Equipment was selected which met the minimum specifications for accurate recording listed by other states. This equipment was installed in different types of Missouri Courts for one month and then rotated to another court, giving each participating court an opportunity to operate each type of equipment. After each month's testing, a questionnaire was filled out by each court's equipment operator to measure the attitude toward operation of each recording system--to include the ease of handling tape, ease of storing tape and ease of monitoring recording.

A random sample of fifteen minutes of each month's total recording was played back and graded to measure the minutes of subaudible recording, of distorted recording, and of extraneous noise. At the end of the period, the machines were rated for comparative quality by the operator and the judge, on a scale of 1 to 5, best to worst. The questionnaire and grade sheets were scored and compared statistically to determine if any recording system performed significantly poorer or better in any type of court. Breakdown and maintenance procedures were also documented and compared. After the recording evaluation, a test of transcription capability was conducted and questionnaires and rating instruments compared to

determine any significant difference in the transcribing ability of each system.

This testing procedure offered the following advantages: a long-term operational test of many types of equipment; comparison and measurement by the court and staff who may be using the systems; the ability to consider the effect of the recording environment on the quality of the recording system. This study design seemed to be the best method to gather unbiased, valid data with which to accurately prescribe specifications for recording equipment for Missouri Courts.

Selection of Subjects

This study is an evaluation of recording equipment, courts and operation personnel. These components of the test are statistically treated as subjects. The following is a discussion of how they were selected for this test and an explanation of their similarities and differences.

Selection of Magnetic Recording Systems

The evaluation of equipment standards of other states, the study of recording system technology and the needs of the courts led to the development of minimum system standards to insure accurate recording for the test in the Missouri Magistrate Courts. These specifications

were listed and sent to known equipment manufacturers and distributors to gather feedback on the specifications and availability of equipment.

Selection Specifications for Audio Recorders for Missouri Courts

1. Required Features

   a. Four-channel Record/Playback

      Four-channel recorders provide separate magnetic tracks for trial participants. Parties recorded speaking at the same time can be transcribed accurately and identified by selecting an individual channel or turning down a distracting channel.

   b. Monitoring Facilities

      Headphone and visual capability to monitor recording after record head through monitor or playback to insure that accurate recording is taking place and allow for adjustment of recording.

   c. Four or more Low-Impedance Balanced Line Microphone Inputs

      One microphone input for judge, witness and each counsel. Balanced, grounded, low impedance microphones and inputs insure against recording of ground loop noise or extraneous electronic signals.

   d. No Erase Head

      Machine must be incapable of erasing previously recorded testimony.

   e. Indexing Capability

      Machine must include an accurate indexing system for logging and later locating testimony for playback and transcription.

f. Record and Transcribe Capability

Unit should be able to record testimony and later be easily moved to act as a transcribing machine in low volume courts to minimize expense.

g. In-Court Playback Capability

Machine must include an amplifier and speaker for incourt playback.

h. At Least Three (3) Hours Continuous Recording

Machine must be capable of at least 3 hours of recording without changing tape. Halting a trial for frequent tape change could be distracting to trial participants.

i. Tape Motion Indication and Security

Tape motion should be identifiable. Machine should stop automatically at end of tape or with a broken tape and give an audible warning.

j. Remote Foot Control for Transcription

Foot control should provide play, fast forward, stop and rewind for easy transcription.

k. Selectable One to Four Channel Playback for Transcription

Transcriber-clerk should be able to select individual channels and alter volume for accurate transcription.

l. Headphone Output for Transcription

To provide accurate and non-distracting transcription.

2. Recommended Features

a. Signal Sensing Device

Machine should be incapable of recording over a tape of existing testimony to

insure against accidental destruction of court records.

b. Foot Control with Automatic Backspace at Stop

Machine should automatically backspace a few inches when stop is selected by transcriptionist to provide for accurate transcription.

c. Lock-up Capability

Machine should be able to be locked to prevent possible tampering.

Returns from the questionnaires sent to known equipment manufacturers showed seven recording systems which would conform to these minimum selection specifications for the test: Baird Atomic, Comptel Sterling, Dictaphone, GYYR, Sony, Sound Arts, and Tascam-Teac. Only five systems were available to test. Sound Arts was developing a new recording machine which was not being marketed at the time of the test. Comptel Sterling chose not to participate because they were unable to acquire a Missouri service facility.

In order to gain maximum exposure of equipment in as many courts as possible, two systems of each of the five manufacturers were acquired. Two systems, one cassette and one reel-to-reel, were purchased through advertisements for bids. These systems could be used in the test and later serve as back-up systems in case of emergency system failure. The bidding procedure provided valuable data on cost and availability of equipment.

The five recording systems tested were all to conform to the selection specifications previously listed. Each system used different types of features to attempt to conform to these specifications. Following is a list and a description of the systems tested. Each system included the following equipment:

1 - recorder/transcriber

3 - cardiod, directional, low impedance balanced line microphones, with cables

1 - omni-directional, low impedance balanced line microphone, with cables

4 - acoustic isolating microphone stands

1 - footpedal

1 - headset

1 - maintenance kit with head cleaner and demagnetizer

Court Recording Systems Tested

The systems tested were: A) Baird Atomic MR-600-4; B) Dictaphone 1043; C) GYYR ACR-4; D) Sony BM-144, TV-14; E) Tascam 33-4. A description of each of these systems follows.

A) Baird Atomic MR-600-4. The Baird Atomic MR-600-4 was a reel-to-reel recorder/transcriber, offering three hours of recording on each 7-inch, 1800-foot tape at 1-7/8 inches per second. This system was designed and

marketed expressly for court use and offered many features and accessories for recording and transcribing.

One unique feature of this system was its dual visual monitoring facilities. Lights for each channel showed the presence of a recorded signal, and four separate meters showed the presence and loudness of the signal.

This system also provided four variable automatic microphone level controls. The controls automatically boost quieter recording and limit recording which was loud enough to cause distortion. The boost of quiet recording was variable providing the ability to limit the amplification of extraneous noise such as air conditioners and traffic.

This system also provided a unique light and buzzer warning to prevent recording over previously recorded testimony. The system refused to record over previous recording, playing back the prior recording automatically. A footpedal was available for this system which has variable backspace at stop. The recorder was housed in a cabinet with a lockable lid to prevent tampering (Baird Atomic Manual).

B) Dictaphone 1043. The Dictaphone 1043 was a reel-to-reel recorder offering three hours of recording

on 7-inch reels and six hours on 1-1/2" reels of tape. The machine operated at 1-7/8 inches per second. This system was manufactured by Scully/Metrotech and marketed by Dictaphone Corporation in two configurations: stand-up or semi-portable mount or desk type, non-portable cabinet.

Six microphone inputs were available to be used in combination with the four channels, i.e., microphone one and two can be combined for channel one, etc.

The 1043 had only one visual meter to manually set microphone volume and to monitor the recording on each of the four channels.

A unique end of tape alarm sounded a buzz when a tape was ended or broken (Dictaphone Manual).

C) GYYR ACR-4. The GYYR ACR-4 system was a dual deck, one case cassette recorder/transcriber offering continuous recording by automatically switching from one deck to another a few minutes before the end of tape. The separate decks recorded at 15/16 inches per second offering one hour of recording per C-60 cassette. This system was manufactured and marketed by GYYR Products, Inc., expressly for court recording and transcribing and offers many unique features.

This system did not include balanced line microphone inputs, but had special radio frequency

inhibiting facilities. These features should have insured against recording of extraneous C.B. and radio broadcasts.

The ACR-4 system did not provide visual monitoring facilities after the record head. The audio headphone monitor was the only indication available that recording was taking place.

This system had a unique electronic counter to note the log and tape position which corresponded to the recorded testimony.

A special scan feature was provided to check tapes for the presence of previous recording. This system ejected tapes which were scanned and showed previous recorded signals.

The ACR-4 system included fast playback speed compression ability for reviewing the tape. The compression circuits were specially designed to limit the alteration of the sound of the fast playback providing more accuracy. The playback volume of each channel of the ACR-4 was variable to provide for accurate playback and transcription of different recording volumes A footpedal was available for use with the system. The footpedal allowed automatic backspace at stop. The amount of backspace was variable but factory set (GYYR Manual).

D) Sony BM-144, TU-14. The Sony BM-144, TU-14 was a cassette, three-part, dual-deck recorder/transcriber offering continuous recording by automatically changing from one BM-144 recorder to another at a few minutes before the end of a tape. The TU-14 control unit provided this continuous recording capability. The separate BM-144 recorders/transcribers operated at 15/16 inches per second offering 1-1/2 hours of recording per each C-90 cassette. This system was modified by Sony for four channel recording and marketed by Sony dealers and distributors.

The Sony system used a special automatic microphone volume control circuit which eliminated setting microphone level. This system boosted quiet recording signals.

Each BM-144 unit had 4 separate lights for visual monitoring of the microphone signal to insure that recording was taking place.

The BM-144 units included variable playback speed controls which slowed down or speeded up the tape (Sony Manual).

Each BM-144 recorder/transcriber could be used as a separate transcriber which permitted using one unit as a recorder while at the same time using the other unit as a transcriber. when using the units separately, the continuous recording time was reduced from 3 hours to

1-12 hours. By having two recorder/transcriber units, there was a back-up in case one machine developed mechanical problems. Variable backspace at stop was controllable on the BM-144 unit itself.

The Sony system would operate only with leaderless cassette tapes.

E) Teac Tascam 33-4. The Teac Tascam 33-4 system was a reel-to-reel recorder, recording at 15/16 ips and playing back at 15/16 ips. The 15/16 ips allowed six hours recording per 7-inch, 1800-foot tape or 12 hours per 10-1/2", 3600-foot tape. This system was manufactured by Teac Corporation and modified by Tascam Corporation, the American distributor of Teac Products. The system was marketed by approved distributors of Tascam Products.

One of many unique features of this system was its four limiting microphone volume controls. The limiting circuits eliminate distorted recording due to loud noises or signals.

A signal over-record inhibitor circuit stopped the tape when previous recording was detected on the tape. A light also came on to notify the operator that a previously recorded signal had been found.

The 33-4 recorder/transcriber provided separate playback volume control for each of the four channels as well as a master volume control.

A recording system was available for recording only at 15/16 ips, but providing playback at 15/16 or 7/8 ips (Tascam Manual).

Magnetic Recording Tape

Magnetic recording tape was also purchased for the test through advertisements for bids. Care was taken to insure that the type of tape specified would conform to each recording system. This arrangement allowed more exact specification of the tape cost per hour for each system. Following is a list of tape used and tape cost per hours of recording for each system.

Systems	Speed of Recording	Tape Specified	Tape Cost Per Hour
A) Baird Atomic	1-7/8 ips	3M-177-4-7	$1.14
B) Dictaphone	1-7/8 ips	3M-177-4-7	1.14
C) GYYR ACR-4	.6 ips	GYYR C-90	1.00
GYYR ACR-4	.6 ips	GYYR C-60	1.33
D) Sony BM-144, TU-14	15/16 ips	Sony C-90	1.66
E) Tascam 33-4	15/16 ips	3M-177-4-7	.57

Selection of Test Courts

Ten courts were needed as testing grounds for the ten recording systems. Fourteen courts which had expressed interest were evaluated and rated to determine variables

of acoustical characteristics, design and size of courtroom, because these factors might affect the operation of the systems and would need to be identified with the results of the test. A review of the literature on acoustics showed smaller courtrooms may have affected channel separation between parties and made identification at transcription difficult. Larger courtrooms may have caused long reverberation time if walls and ceilings were not covered with sound absorbing materials. Long reverberation time causes persistence of sound which may interfere with the next recorded word. Extraneous noise may also have interfered with the recording of proceedings making it inaudible. Extraneous noise can be caused by traffic, loud air conditioners or heaters. Extraneous noise could be isolated by double glass windows, acoustical tile, carpet or heavy doors. A few courts had been built recently or refinished to include acoustical absorbant material, such as carpet and acoustical tile. These courts displayed excellent sound quality. Also, certain courts operated without a clerk in the courtroom. Others had clerks and some had both clerks and bailiffs. Courts also differed as to their caseloads. All these variables were taken into consideration to try to select as many different types of courts as possible, thereby adding validity to the testing procedure and generalizability to the results.

Ten courts were selected by the Chief Justice of the Missouri Supreme Court and grouped by the investigator and members of the staff of the Courts Administrator's Office.

Group I

A) Callaway County Magistrate/Probate Court
B) Jefferson County Magistrate Court Division 1
C) St. Charles Magistrate Court Division 2
D) St. Louis City Circuit Court Division 14
E) St. Louis County Magistrate Court Division 4

Group II

A) Cole County Magistrate Court
B) Cooper County Magistrate Court
C) Jackson County Magistrate Court Division 7
D) Jackson County Magistrate Court Division 4
E) Saline County Magistrate/Probate Court

Following is an explanation of each court in which recording systems were tested.

Group I

A) Callaway County Magistrate/Probate Court

Fulton, Missouri

314-642-5514

Judge - Patrick Horner

Operators - Elsie Morton and other clerks

Acoustics - Fair

Size of Courtroom - Medium

This courtroom showed a high degree of echo and extraneous noise. The extraneous noise was due to the sound of large trucks on the adjacent street and the window air conditioner. The air conditioner was normally turned off during the court sessions.

B) Jefferson County Magistrate Court Division 1

Hillsboro, Missouri

314-789-3911

Judge - Charles Sheehan

Operator - Bud Skaggs

Acoustics - Good

Size of Courtroom - small

This court showed a small degree of echo and extraneous noise. The small size of the courtroom may necessitate redesign of the clerk area if a recording machine is to be used to provide efficient work space, and not distract from audio quality of the recording system.

C) St. Charles Magistrate Court Division 2

St. Charles, Missouri

314-724-2414

Judge - Richard K. Zerr

Operator - Judy Oetting

Acoustics - Excellent

Size of Courtroom - Small

This court exhibited excellent acoustics due to carpet, wooden paneling and acoustical ceiling tile. This court was small, but exhibited no loss of channel separation.

D) St. Louis City Circuit Court Division 14

St. Louis, Missouri

314-453-4278

Judge - Daniel B. Tammany

Operator - Lowell Felix

Acoustics - Good

Size of Courtroom - Medium

This court was the only court which tried only non-contested dissolution of marriage cases. The audio recorders tested were to be used for preserving the record of these cases. (It should be noted that the first recording system--Dictaphone--was tested in Magistrate Court Division 20. The acoustics of these courtrooms are similar as all courtrooms in this building have a very similar design). The acoustics of this courtroom showed some echo and extraneous noise due to marble floors. This effect could be limited by carpet.

E) St. Louis County Magistrate Court Division

Clayton, Missouri

314-889-2660

Judge - Samuel J. Hais

Operator - Vincent Anth

Acoustics - Excellent

Size of Courtroom - Large

This court showed excellent acoustics due to acoustical treatment of the ceiling and carpet on the floor. The courtroom was large, but very well designed for audio recording. It was the best example of an excellent courtroom recording environment of the courtrooms used for testing.

Group II

A) Cole County Magistrate Court

Jefferson City, Missouri

314-636-8242

Judge - F. Randall Waltz

Operator - Judge F. Randall Waltz

Acoustics - Fair

Size of Courtroom - Small

This court was one of the two courts in which the judge operated the recording system. The clerk of this court did not normally work in the courtroom. The judge's bench

was large enough to facilitate the placement of a recorder. This courtroom exhibited acoustical flaws of both extraneous noise and echo due to tile walls and floor and hard ceiling. The window air conditioning unit was very noisy.

B) Cooper County Magistrate/Probate Court

Boonville, Missouri

816-882-6179

Judge - Kenton Askren

Operator - Debbie Pulliam

Acoustics - Poor

Size of Courtroom - Large

The Circuit Courtroom was selected for the recording test in this county. The large courtroom exhibited the worst acoustics of any court selected for testing. The hard surfaces of this courtroom produced a large amount of echo which greatly reduced audible quality of recording. The Judge and Sheriff of this court mentioned that many court participants, most notably the jury, have complained of inability to hear court proceedings clearly.

C) Jackson County Magistrate Court Division 7

Grandview, Missouri

816-761-8410

Judge - Louis Davis

Operator - Clara Burton

Acoustics - Good

Size of Courtroom - Medium

Acoustics in this courtroom did not seem to be a deterrent to audio quality of recording proceedings.

D) Jackson County Magistrate Court Division 4

Kansas City, Missouri

816-881-3726

Judge - Robert W. Berrey III

Operator - Nancy Kelley

Acoustics - Good

Size of Courtroom - Medium

This courtroom showed a few acoustical problems. Instances of extraneous traffic noise were noted.

E) Saline County Magistrate/Probate Court

Marshall, Missouri

816-886-6988

Judge - Lawrence McClure

Operator - Suzanne Westbrock and Judge McClure

Acoustics - Fair

Size of Courtroom - Small

This courtroom displayed extraneous typewriter noise because the typing was done in the back of the courtroom.

A partition separating the clerk area lowered this effect somewhat. The Judge operated the recording system in this court.

Selection of Subjects for Transcription Test

Five experienced typists were selected for testing the transcription capability of the recording systems. These subjects were not experienced in court transcript preparation or legal terminology. All of the subjects had used transcribing equipment to a limited degree.

Instrumentation

The following materials were developed to answer research questions and the following hypotheses.

Research Question 1

Research Question 1 was stated:

> Does equipment which meets the selection specifications developed perform significantly poorer or better in ease of operation and quality of of recording and transcribing?

From this question the following hypotheses were generated.

H1 = There is no statistically significant difference among mean scores for operating ease in Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

H2 = There are no statistically significant differences among mean recording accuracy scores for Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

H3 = There are no statistically significant differences among mean scores for operating ease in Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

H4 = There are no statistically significant differences among mean recording accuracy scores for Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

H5 = There are no statistically significant differences among mean transcription scores for all systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam).

Operation Ease. A questionnaire was developed to evaluate the operators' attitudes on specific procedures of operation of the recording systems. Ten questions were listed and a Likert-based evaluation system was included.

No sample questionnaire was available upon which to base the design of the instrument. The questions were carefully developed and reviewed by the investigator and the staff of the Court Administrator's office to avoid ambiguous language and to insure clarity of measurement.

A Kuder-Richardson 20 reliability test was run on the combined instruments and revealed a result of 0.83. A copy of the questionnaire follows.

MAGISTRATE COURT

AUDIO RECORDING ANALYSIS

OPERATOR QUESTIONNAIRE

COURT: _____ DATE: _____

NAME: _____

OCCUPATION: _____

RECORDING SYSTEM: _____

1. Monitoring this recording system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

2. Logging this recording system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

3. Locating previously recorded testimony on this system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

4. Handling tape on this system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

5. Accurately adjusting recorder volume was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

6. Headphones were:

Extremely Comfortable					Extremely Uncomfortable
1	2	3	4	5	6

7. Playing back testimony on this particular system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

8. With this system, performing my normal duties of court is:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

9. Overall, operation of this particular recording system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

10. Storing tape recorded on this particular system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

Recording Accuracy. An evaluation instrument was developed with which to evaluate the accuracy of recording of each particular system. Gradings were divided into separate areas of subaudible recording, extraneous noise, and distorted recording. These areas were selected after review of literature on audio recording and statements of transcribers of audio court records. These areas were noted as possible deterrents to accurate transcript preparation. An example of this instrument follows.

MAGISTRATE AUDIO COURT RECORDING PROJECT

GRADE SHEET

RECORDING ACCURACY

Court_____ Machine_____

Date_____

Total Recording Time_____

	MINUTES															
ERRORS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total
1. Subaudible Recording																
2. Extraneous Noise																
3. Distorted Recording																

TOTAL ERRORS_____

Comments:

Transcription Ease. A Likert-based questionnaire was developed to evaluate the transcription operator's attitude about the functioning of each recording system. Care was taken to insure against ambiguous language and to insure clarity of measurement by having the instrument reviewed by the investigator and the staff of the Court Administrator's Office. Due to the small amount of questionnaires used (five), no reliability was developed.

MAGISTRATE COURT

AUDIO RECORDING ANALYSIS

TRANSCRIBING QUESTIONNAIRE

NAME: _____

RECORDING SYSTEM: _____

1. Handling tape on this system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

2. Accurately adjusting transcriber volume was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

3. Headphones were:

Extremely Comfortable					Extremely Uncomfortable
1	2	3	4	5	6

4. Identification of index number on this system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

5. Operation of the footfeed on this particular system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

6. Overall, transcribing on this particular recording system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

7. Identification of parties on this particular system was:

Extremely Simple					Extremely Difficult
1	2	3	4	5	6

Research Question 2

Research Question 2 was stated as follows:

When courts are asked to rate their preference for recording systems, will the ratings agree between Groups I, II and the transcription group?

Preference. To answer Research Question 2, the Court was asked, after testing all of the systems, to rate the comparative quality of all the court recording systems tested with the following score sheet.

RATING OF OVERALL QUALITY

NAME: _____

DATE: _____

COURT: _____

If price is no factor, please rate from first to fifth (1-5), best to worst, the comparative quality of the court reporting systems tested in your court. You cannot rate two machines equally.

SYSTEM	RATING
Baird Atomic	
Dictaphone	
GYYR	
Sony	
Tascam-Teac	

Comments:

Data Collection

Recording Test

The court recording/transcribing equipment was placed for testing in the ten courts selected to participate in the study for one-month periods according to the following schedule:

SCHEDULE

Group I

Approx. Dates	St. Louis County	St. Louis City	St. Charles	Jefferson	Callaway
AUG.	Sony	Dictaphone	Baird Atomic	Tascam	GYYR
SEPT.	Baird Atomic	Sony	GYYR	Dictaphone	Tascam
OCT.	GYYR	Baird Atomic	Tascam	Sony	Dictaphone
NOV.	Tascam	GYYR	Dictaphone	Baird Atomic	Sony
DEC.	Dictaphone	Tascam	Sony	GYYR	Baird Atomic

Group II

Approx. Dates	Jackson County K.C.	Grandview	Cooper	Saline	Cole
AUG.	Tascam	Dictaphone	GYYR	Sony	Baird Atomic
SEPT.	Dictaphone	Sony	Baird Atomic	GYYR	Tascam
OCT.	Sony	GYYR	Tascam	Baird Atomic	Dictaphone
NOV.	GYYR	Baird Atomic	Dictaphone	Tascam	Sony
DEC.	Baird Atomic	Tascam	Sony	Dictaphone	GYYR

After each one-month recording session, the Operation Ease Questionnaire was given to the operator of the system. The operator filled out the questionnaire personally and with no time limit.

During the time the operator was filling out the questionnaire, a random sample of fifteen minutes of the month's recording was played over the system's headphones. This playback was used by the investigator to measure any evidence of subaudible recording, extraneous noise, or distorted recording on the Audio Accuracy Grade Sheet. After each system was scored, the new system was installed.

After all of the recording sessions (five months) during which each operator had used all of the recording systems, the operators were given the court preference sheet and asked to rate their preferences, best to worst, of the recording systems. No time limit was given for completion.

Transcription Test

The unique index counters for logging on each of the recording systems would necessitate that the type system used for recording also be used for transcription. This important factor required a test of transcription capability of the selected recording systems. The

specifications for test systems called for both recording and transcribing capability. Therefore, at the end of the recording test, one model of each of the systems was randomly selected for testing.

A sample tape for each system was also randomly selected for transcription from the tapes collected during recording.

Five typists experienced in transcribing from dictation equipment were selected to transcribe these tapes. These typists were selected in order to simulate normal staffing of transcription services and courts.

The selected model of each of the five systems was set up for transcription. The system included: recorder/transcriber, headphone, footpedal and typewriter.

The transcription test began with a fifteen-minute training session on each transcribing system. After the training session each of the five individuals selected for the test was asked to transcribe on each system for forty-five minutes. After each transcription session, the individuals were given ten minutes to fill out a questionnaire on transcription ease of each machine. At the end of the last test, the individuals were asked to complete the transcription preference sheet, rating the systems best to worst. No time limit was given.

Speed of transcribing and accuracy were not recorded for it was believed that these factors could not be adequately attributed to system difference, but may only reflect transcribers' differences.

Data Analysis

The objective of this research was to determine if any of the recording/transcribing systems selected for evaluation performed significantly poorer or better than others in selected courts. From the data generated in this study, the selection criteria originally drawn could be evaluated and revised, if necessary, to make final recommendation to the courts.

Two 5 x 5 factorial analyses of variance were performed on mean scores of operating ease, transcription ease, and recording accuracy. This inferential statistical method was used because it provided the potential ability to evaluate whether any of the scores of these variables could be attributed to chance. This statistic also provided the potential to predict performance of systems in courts.

A Kuder-Richardson 20 reliability test was performed on the combined operating ease scores to determine the reliability of this instrument.

A Scheffé post hoc comparison was completed on the statistically significant transcription ease evaluation to determine which means contributed to the overall significant F score.

The court preference scores could not be treated as inferential statistics. The preference scores were totaled and compared between groups I, II and the transcription group to determine if similarities or differences existed.

CHAPTER IV

RESULTS

The objective of this research was to determine if any of the recording/transcribing systems selected for evaluation performed significantly poorer or better than others in the selected courts. From the data generated in this study, the selection criteria originally drawn could be evaluated and revised, if necessary, to make final recommendation to the courts.

Analysis was divided into Testing Court Recorder Groups I and II, and transcriber's operating ease, recording accuracy and court preference scores were evaluated for Court Groups I and II. Operating ease and transcription preference scores were evaluated for the transcriber group. These evaluations are listed in tables by research question and hypothesis.

Research Question One

Research Question 1 was stated as follows, and contained five hypotheses:

> Does equipment which meets the selection specifications perform significantly poorer or better in operating ease, recording accuracy and transcription ease?

Hypothesis One

The first hypothesis was stated in the following manner:

> H1 = There are no statistically significant differences among mean scores for operating ease in recording Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

The data gathered for this hypothesis are shown in Table 1.

TABLE 1

OPERATING EASE - GROUP I

	Systems					
Courts	Dictaphone	Baird Atomic	GYYR	Sony	Tascam	Mean
Callaway	18.0	10.0	24.0	10.0	14.0	15.2
St. Charles	25.0	19.0	41.0	25.0	15.0	25.0
St. Louis County	22.0	25.0	19.0	10.0	20.0	19.2
St. Louis City	24.0	32.0	34.0	19.0	20.0	25.8
Jefferson	36.0	19.0	15.0	20.0	28.0	23.6
MEAN	25.0	21.0	26.0	16.8	19.4	

To ascertain whether or not a significant difference existed among means reported in Table 1, a two-way analysis of variance was used. A summary of the analysis is reported in Table 2.

TABLE II

ANALYSIS OF VARIANCE OF OPERATING EASE SCORES FOR GROUP I

Source	SS	DF	MS	F
Courts	398.962	4	99.741	1.979
Systems	323.362	4	80.841	1.604
Error	205.238	16	80.390	
TOTAL	528.563	24		
Critical Values $p < .05$				
4 and 16	3.01			
4 and 16	3.01			

The F values of 1.979 for Courts did not surpass the required F value of 3.01 for 4 and 16 degrees of freedom at the .05 level. The F value for systems was 1.604, which did not surpass the required 3.01 F value at the .05 level; therefore, Hypothesis H1 could not be rejected.

Hypothesis Two

The second hypothesis was stated in the following manner:

> H2 = There are no statistically significant differences among mean recording accuracy scores for Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

The data gathered for this hypothesis are shown in Table 3.

TABLE 3

RECORDING ACCURACY - GROUP I

	Systems					
Courts	Dictaphone	Baird Atomic	GYYR	Sony	Tascam	Mean
Callaway	18.0	0.0	8.0	0.0	3.0	2.8
St. Charles	3.0	3.0	2.0	0.0	2.0	2.0
St. Louis County	3.0	0.0	3.0	2.4	3.0	2.4
St. Louis City	6.0	2.0	0.0	1.0	2.0	2.2
Jefferson	2.0	3.0	2.0	2.0	1.0	2.0
MEAN	3.4	2.2	3.0	.6	2.2	

To ascertain whether or not a significant difference existed among means reported in Table 3, a two-way analysis of variance was used. A summary of the analysis is reported in Table 4.

The F value for Courts scores of 0.161 did not surpass the required F Value of 3.01 needed to reject the hypothesis at the .05 level. The F value for systems was 1.653, which did not surpass the required 3.01 F value for 4 and 16 degrees of freedom; therefore Hypothesis H2 could not be rejected.

TABLE 4

ANALYSIS OF VARIANCE OF RECORDING ACCURACY SCORES FOR GROUP I

Source	SS	DF	MS	F
Courts	2.240	4	0.560	0.161
Systems	23.040	4	5.760	1.653
Error	55.760	16	3.485	
TOTAL	81.040	24		
Critical Values $p < .05$				
4 and 16	3.01			
4 and 16	3.01			

Hypothesis Three

The third hypothesis was stated in the following manner:

> H3 = There are no statistically significant differences among mean scores for operating ease in Group II Systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II Courts.

The data gathered for this hypothesis are shown in Table 5.

TABLE 5

OPERATING EASE - GROUP II

Courts	Systems					Mean
	Dictaphone	Baird Atomic	GYYR	Sony	Tascam	
Cole	30.0	25.0	15.0	13.0	24.0	21.4
Cooper	31.0	18.0	23.0	17.0	15.0	21.8
Saline	29.0	23.0	18.0	20.0	33.0	24.6
Kansas City - Grandview	21.0	10.0	22.0	10.0	20.0	16.6
Kansas City	27.0	31.0	43.0	15.0	21.0	27.4
MEAN	27.6	21.4	24.2	15.0	22.6	

To ascertain whether or not a significant difference existed among means reported in Table 5, a two-way analysis of variance was used. A summary of analysis is reported in Table 6.

TABLE 6

ANALYSIS OF VARIANCE OF OPERATING EASE SCORES FOR GROUP II

Source	SS	DF	MS	F
Courts	333.763	4	23.441	1.916
Systems	428.963	4	107.241	2.463
Error	696.637	16	43.540	
TOTAL	1459.363	24		
Critical Values $p < .05$				
4 and 16	3.01			
4 and 16	3.01			

The F values for Courts, 1.916, did not surpass the required F value of 3.01 for 4 and 16 degrees of freedom. The F value of systems was 2.463, which did not surpass the needed 3.01 F value at the .05 level; therefore Hypothesis H3 could not be rejected.

Hypothesis Four

The fourth hypothesis was stated in the following manner:

> H4 = There are no statistically significant differences among mean recording accuracy scores for Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

The data gathered for this hypothesis are shown in Table 7.

TABLE 7

RECORDING ACCURACY - GROUP II

	Systems					
Courts	Dictaphone	Baird Atomic	GYYR	Sony	Tascam	Mean
Cole	8.0	3.0	2.0	2.0	4.0	3.8
Cooper	5.0	2.0	13.0	2.0	0.0	4.4
Saline	4.0	4.0	4.0	1.0	2.0	3.0
Kansas City Grandview	2.0	3.0	2.0	1.0	2.0	2.0
Kansas City	2.0	8.0	5.0	2.0	2.0	3.8
MEAN	4.2	4.0	5.2	1.6	2.0	

To see whether or not a significant difference existed among means reported in Table 7, a two-way analysis of variance was used. A summary of the analysis is reported in Table 8.

TABLE 8

ANALYSIS OF VARIANCE OF RECORDING ACCURACY SCORES FOR GROUP II

Source	SS	DF	MS	F
Courts	17.200	4	4.300	0.566
Systems	47.200	4	11.800	1.553
Error	121.600	16	7.600	
TOTAL	186.000	24		
Critical Values $p < .05$				
4 and 16	3.01			
4 and 16	3.01			

The F value for Court scores, 0.566, and the F value for systems, 1.553, did not surpass the F value of 3.01 required to reject the hypothesis at the .05 level. H5 could not be rejected.

Hypothesis Five

The fifth hypothesis was stated in the following manner:

> H5 = There are no statistically significant differences among mean transcription scores for all systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam).

The data gathered for this hypothesis are shown in Table 9.

TABLE 9

TRANSCRIPTION EASE

	Systems					
Courts	Dictaphone	Baird Atomic	GYYR	Sony	Tascam	Mean
Operator 1	14.0	23.0	10.0	27.0	30.0	20.8
Operator 2	16.0	16.0	17.0	20.0	23.0	18.4
Operator 3	12.0	11.0	15.0	11.0	24.0	14.6
Operator 4	24.0	21.0	16.0	17.0	35.0	22.6
Operator 5	11.0	27.0	16.0	16.0	31.0	20.2
MEAN	15.4	19.6	14.8	18.2	28.6	

To ascertain whether or not a significant difference existed among means reported in Table 9, a two-way analysis of variance was used. A summary of this analysis is reported in Table 10.

TABLE 10

ANALYSIS OF VARIANCE OF TRANSCRIBING EASE SCORES

Source	SS	DF	MS	F
Transcribers	184.241	4	46.060	2.112
Systems	616.241	4	154.060	7.064
Error	348.959	16	21.810	
TOTAL	1149.441	24		
Critical Values $p < .05$				
4 and 16	3.01			
4 and 16	3.01			

The F values for transcribers scores, 2.112, did not surpass the required F value of 3.01 for 4 and 16 degrees of freedom at the .05 level. The F value for systems was 7.064, which exceeded the needed 3.01 F value for significance at the .05 level for 4 and 16 degrees of freedom.

To identify the systems which differed significantly, the Scheffé method of post hoc comparisons was applied to determine pair-wise differences between means. The Scheffé test revealed that the Tascam mean score was significantly higher than the other systems' mean scores at the .05 level. The results of the Scheffé test are reported in Table 11.

TABLE 11

SCHEFFÉ TEST FOR DIFFERENCE AMONG MEANS FOR TRANSCRIBING EASE SCORES OF SYSTEMS

		Systems Group			
	Mean	Baird Atomic	GYYR	Sony	Tascam
System Mean Group		19.6	14.8	18.2	28.6
Dictaphone	15.4	- 4.2	.6	- 2.8	-13.2
Baird Atomic	19.6		4.8	1.4	- 9.
GYYR	14.8			- 3.4	-13.8
Sony	18.2				-10.4

$p < .05 = \pm 6.23$

The differences in means between the Tascam system and the other systems surpassed the ±6.23 level needed to show significant differences at the .05 level. The other system differences did not reach the ±6.23 level.

Research Question Two

Research Question 2 was stated as follows:

> When courts are asked to rate their perferences for recording systems, will the ratings agree between Groups I, II and the transcription group?

The data gathered to answer Research Question 2 are shown in Tables 12, 13, and 14. Final comparisons are shown in Table 15.

Table 12

GROUP I COURT PREFERENCE

	Systems				
Courts	Dictaphone	Baird Atomic	GYYR	Sony	Tascom
Callaway	3	2	5	1	4
St. Charles	3	1	5	4	2
St. Louis	5	2	4	1	3
St. Louis County	2	4	3	1	5
Jefferson	5	1	4	3	2
TOTAL	18	10	21	10	16
Ranking	3	1	4	1	2

Although it is not possible to prove that differences among rankings are real differences, that is, that they would occur reliably with all operators, it is interesting to note that for this group of courts, a clear preference for Sony and Baird Atomic systems is shown and that Dictaphone is least preferred. Comparisons of rankings of preference of Court Groups I, II, and transcribers are shown in Table 15.

TABLE 13

GROUP II COURT PREFERENCE

	Systems				
Courts	Dictaphone	Baird Atomic	GYYR	Sony	Tascam
Cole	5	3	1	2	4
Cooper	4	1	5	2	3
Kansas City	3	2	5	1	4
Kansas City Grandview	3	1	4	2	5
Saline	1	3	5	2	4
TOTAL	16	10	20	9	18
Ranking	3	2	5	1	4

Although it is not possible to prove that differences among rankings are real, that is, that they would occur reliably with all operators, it is interesting to

note that for this group of courts, a clear preference for Sony and Baird Atomic systems is shown again. Dictaphone is preferred third and GYYR is least preferred. Comparisons of rankings of Court Groups I, II and transcribers are shown in Table 15.

TABLE 14

TRANSCRIPTION PREFERENCE

	Systems				
Transcription	Dictaphone	Baird Atomic	GYYR	Sony	Tascam
Transcriber 1	2	3	1	4	5
Transcriber 2	1	4	3	2	5
Transcriber 3	2	4	1	3	5
Transcriber 4	4	3	1	2	5
Transcriber 5	1	4	2	3	5
TOTAL	10	18	8	14	25
Ranking	2	4	1	3	5

Although it is not possible to prove that differences among these rankings are real, that is, that they would occur reliably with all transcribers, it is interesting to note that for the transcribers, a clear preference is shown for the GYYR system. Dictaphone ranked second and Tascam was least preferred. Comparisons of preference rankings of Court Groups I, II and transcribers are shown in Table 15.

TABLE 15

COMPARISONS OF PREFERENCE RANKINGS OF COURT GROUPS I, II AND TRANSCRIBERS

Ranking of Preference	Systems				
	Dictaphone	Baird Atomic	GYYR	Sony	Tascam
Court Group I	3	1	4	1	2
Court Group II	3	2	5	1	4
Transcribers	2	4	1	3	5
TOTAL	8	7	10	5	11
Final Ranking	3	2	4	1	5

Although it is not possible to prove that differences among these rankings are real, that is, that they would occur reliably with all courts and transcribers, it is interesting to note the difference between transcriber rankings and Court Group rankings. Most specifically, the fourth and fifth ranking of the GYYR machine in Grout Group I and II and its first ranking in the transcription group should be noted.

CHAPTER V

DISCUSSION

The purpose of this study was to evaluate magnetic court recording/transcribing systems in order to develop specifications for the Missouri Associate Circuit Courts. The data analyses of this study were designed to determine if any of the recording/transcribing systems selected for evaluation performed significantly poorer or better than others in selected courts. From the data generated through this analysis, the selection criteria originally drawn for evaluation could be revised, to provide final selection specifications for accurate and efficient court recorders/transcribers needed by the Associate Circuit Courts.

This chapter will discuss the results of this evaluation. The discussion will be organized by research question and corresponding hypothesis. In addition, a discussion of results by recording system is included in this chapter.

Research Question One

Research Question 1 asked "Does equipment which meets the selection specifications perform significantly

poorer or better in operating ease, recording accuracy and transcription ease?"

From this question, five hypotheses were formulated. This chapter will discuss each of these hypotheses in the order they were stated earlier in the study.

Hypothesis One

The first hypothesis states:

> H1 = There are no statistically significant differences among mean scores for operating ease in recording Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

The two-way analysis of variance used to evaluate this hypothesis showed no significant difference in mean scores of operating ease of courts or systems in Group I. The investigator therefore was not able to reject this hypothesis.

Data accumulated to test this hypothesis consisted of twenty-five Likert-based questionnaires given to the operators after one month's use of each recording system. A Kuder-Richardson 20 reliability test performed on the questionnaires revealed a reliable 0.83 score.

From these results, the investigator could not conclude that the selection specifications developed would exclude recording systems which operated in any superior or inferior manner during the tests in these courts.

The selection specifications used to select tested systems were developed by evaluating specifications developed by other states which were already using magnetic recording/transcribing systems in their courts. The specifications therefore, had a high degree of reliability. However, new equipment was tested in this study, which was not available when the other states' specifications were developed. For example, the GYYR and Tascam systems began distribution at the time this study began. Also, the other states' specifications could not consider the possibly unique acoustical and operational nature of the Missouri courts. These factors seemed to have no significant effect on the outcome of this test. In the review of the literature, no similar operational study was revealed with which to compare results.

In conclusion, the evaluation of this hypothesis developed no operational reason to change the existing selection specifications for magnetic recording/ transcribing systems in the Missouri Associate Circuit Courts.

Hypothesis Two

The second hypothesis states:

H2 = There are no statistically significant differences among mean recording accuracy scores for Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

The two-way analysis of variance used to evaluate this hypothesis showed no significant differences in mean scores of recording accuracy for systems or courts in Group I. The investigator was therefore not able to reject this hypothesis.

Data accumulated to test Hypothesis Two consisted of 25 error scores of total minutes of extraneous noise, subaudible recording and distorted recording. A random sample of 15 minutes of one month's recording was reviewed.

From the results of this test, the investigator could not conclude that the selection specifications developed would exclude recording systems which operated with any superior or inferior accuracy in Group I courts.

The selection specifications used to select tested systems had been developed by other states which were using magnetic recording/transcribing equipment in their courts. The specifications therefore already had a high degree of reliability. However, new equipment which was not available when the other states developed their specifications was tested. For example the GYYR and the Tascam systems began distribution at the time this study began.

Also, other states' specifications could not take into consideration the unique acoustical quality of the test courts. The scores do show that the courts with

poor acoustics had a higher degree of error rate but not high enough to affect the results of the test of significance.

The highest degree of recording accuracy error was in the area of extraneous noise. This effect occurred mostly in the large urban areas in the way of Radio Frequency interference. Most of these problems were corrected by service calls by the system suppliers.

References were made in the literature to recording problems of "coughing, footsteps, rustling of paper and other extraneous noises" (Rodebaugh, 1961, p. 1168). These problems were not experienced to a great degree in this recording accuracy evaluation. A possible reason for this may be the use of acoustic isolating microphone stands with padded bases to suppress such extraneous noise.

In conclusion, the evaluation of this hypothesis developed no audible reason to change the existing selection specifications for magnetic recording/transcribing systems in the Missouri Associate Circuit Courts.

Hypothesis Three

The third hypothesis states:

H3 = There are no statistically significant differences among mean scores for operating ease in Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

The two-way analysis of variance used to evaluate this hypothesis showed no significant difference in mean scores of operating ease of courts or systems in Group II. The investigator therefore was not able to reject this hypothesis.

Data accumulated to test this hypothesis consisted of twenty-five Likert-based questionnaires given to the operators after one month's use of each recording system. A Kuder-Richardson 20 reliability test performed on the questionnaires revealed a reliable 0.83 score.

From these results, the investigator could not conclude that the selection specifications developed would exclude recording systems which operated in any superior or inferior manner during the tests in these courts.

Due to the similarity of findings, please refer to Hypothesis One for further discussion.

Hypothesis Four

The fourth hypothesis states:

> H4 = There are no statistically significant differences among mean recording accuracy scores for Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

The two-way analysis of variance used to evaluate this hypothesis showed no significant difference in mean

scores of recording accuracy for systems or courts in Group I. The investigator was therefore not able to reject this hypothesis.

Data accumulated to test Hypothesis Four consisted of twenty-five error scores of total minutes of extraneous noise, subaudible recording, and distorted recording. A random sample of 15 minutes of one month's recording was reviewed.

From the results of this test, the investigator could not conclude that the selection specifications developed would exclude recording systems which operated with any superior or inferior accuracy in Group II courts.

Due to similarity of findings, please refer to research Hypothesis Two for further discussion.

Hypothesis Five

The fifth hypothesis stated:

> H5 = There are no statistically significant differences among mean transcription scores for all systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam).

The two-way analysis of variance used to evaluate this hypothesis showed a significant difference in mean scores of transcribing systems at the .05 level. The Scheffé method of post hoc comparisons revealed that the Tascam system's score was significantly higher than the other system scores at the .05 level. Hypothesis Five was therefore rejected.

No significant differences were found in transcribers' scores at the .05 level.

Data accumulated for this evaluation consisted of twenty-five Likert-based questionnaires given to the transcribers after forty-five minutes of transcribing from each system.

Comments noted during the transcription test revealed that two possible factors may account for the significantly poorer Tascam score. The first of these is that the headphone volume of the Tascam system was notably lower than the other systems. Study revealed that this was caused by an impedance mismatch between the headphone and headphone output. The lower output volume made it difficult to hear over typewriter noise. This would naturally result in an inferior transcript. After the test was completed, the Tascam distributor supplied a properly matched headphone and the sound level was increased to the proper level. The headphone problem demonstrated the necessity of revising the specifications to include performance requirements statements of proper headphone volume.

A second problem with the Tascam machine was noted which also may have contributed to the significantly poorer transcribing system score. The non-automatic backspace at Stop of the Tascam system (a recommended

feature on the selection specifications) made it difficult to retain tape position for transcription. A transcriber cannot usually type at the speed of speech playback. When the transcriber stops, he or she must often listen to a previous portion of a sentence to insure the proper tape position. The automatic backspace feature on most recorder/transcribers does this automatically. The Tascam machine required manually pressing the fast rewind portion of the footpedal. This caused the transcriber to often rewind too far, lose the reference words and become confused. This may result in a poor and slower transcript. For this reason, the selection specifications should be changed to require automatic backspace at Stop.

Research Question Two

Research Question Two was phrased, "When courts are asked to rate their preferences for recording systems, will the ratings agree between Groups I, II and the transcription group?"

Although it was not possible to prove that differences in the rankings of preference would occur reliably, it is important to note that differences did exist.

Ratings of preference were very similar between Court Groups I and II. Both groups preferred the Sony system and the Baird Atomic system for the first two positions. The other three positions were also similar.

Ratings of preference differed between Court Groups and transcribers. Although the Baird Atomic and Sony systems ranked first and/or second in Courts' preferences, the systems ranked third and fourth in transcribers' preferences.

Possible reasons for these differences are that the features provided in the systems are better for court recording than transcribing. Another possible explanation is that the short term of the transcription test may have limited the transcriber's ability to truly rate the systems. These factors are important for courts may need to transcribe as well as record testimony, therefore, the best recorder/transcriber must be selected. Final rankings listed in Table 15 give a possible method of comparison and choice.

Discussion of Results by Recording System

Following is a summary of the comparisons of non-statistical results by recording system. A discussion of mechanical failure is included in this section. Systems are listed in order of the final ranking shown in Table 15.

1) Sony BM-144, TU-14

The Sony system showed the best overall score. It displayed ease of operation, advantages of continuous

recording and automatic microphone control. In addition, it showed no mechanical failure during the test period. The only disadvantage mentioned during the recording test period was the somewhat inaccurate digital counter.

The transcription scores of the Sony machine ranked it third. Disadvantages noted were the one volume control for all four-channel playback, the low headphone playback volume, and the inaccurate index counter. The transcription test also showed advantages of variable speed control for playback and variable backspace control.

2) Baird Atomic MR-600-4

This system showed advantages in recording of variable automatic microphone volume control, accurate index counter, and over-record protection. The one-package, light, portable, locking walnut case was also a noted advantage. Disadvantages noted with this system were the necessity of changing tape after three hours of recording and the two instances of radio frequency interference.

The transcribing scores on the Baird Atomic ranked it fourth among systems. Disadvantages noted were its one master output control for all four channels and its uncomfortable headphones. Advantages listed were the automatic backspace feature, loud output, and lighted indicator for channels.

3) Dictaphone 1043

Both court ratings of preference for the Dictaphone were third. The noted recording disadvantages of this system were: the recording of radio frequencies in two locations; its large size; its single recording indicator meter; and feedback during playback. Advantages noted were the accurate index counter and the availability of a desk-type case.

The Dictaphone system ranked second in the transcribing test. Advantages noted were the good fidelity of playback, comfortable headphones and accurate index counter. Disadvantages noted were non-automatic backspace, footpedal, single output volume control and meter.

4) GYYR ACR-4

The GYYR system rated fifth and fourth in court preference. The disadvantages noted for this system were: the complexity of operation; returning to the beginning of tape; the destruction of tape; intermittent playback distortion; and failure of the index counters. These mechanical problems were corrected by service personnel or by machine replacement, but too late not to affect scores. Advantages noted were the lighted channel index counters, the search system for finding tape position, the compact size, table top design, and the continuous recording.

The transcriptions test of the GYYR ranked it best of all systems. This should be taken into consideration for many advantages were noted: variable volume controls for each channel; automatic backspace at stop; accurate index counters; automatic search for tape position; and compact desk-top design. No transcription disadvantages were noted.

5) Tascam 33-4

The court preference of the Tascam machine ranked it second in Group I and fourth in Group II. The lower ratings in Group II can be attributed to the intermittent failure of the take-up reel in two of the courts. The machine showed advantages of longer recording time (six hours) and the inability to record over previously recorded material.

The fifth place ranking in transcription definitely affected its total score. Problems noted were failure to play loud enough over the headphones to overcome typewriter noise. This could be corrected by proper selection of headphones by the supplier. Also noted as a disadvantage was the non-automatic backspace of this system. This feature was available but not delivered in time for the test. Some advantages noted in transcribing on this system were the variable output volumes of each of the four channels and its large channel indicators.

CHAPTER VI

CONCLUSIONS AND RECOMMENDATIONS

This study began by legislative mandate which required the Office of the State Courts Administrator to develop specifications for electronic court recording equipment for the expanding Missouri Circuit Courts. A long-term test was undertaken and the results analyzed to determine if any of the recording/transcribing systems selected for evaluation performed significantly poorer or better than others in selected courts.

Conclusions

The data of this study would appear to warrant the following conclusions:

1. There are no statistically significant differences among mean scores for operating ease in recording Group I systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

2. There are no statistically significant differences among mean recording accuracy scores for Group 1 systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group I courts.

3. There are no statistically significant differences among mean scores for operating ease of Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

4. There are no statistically significant differences among mean recording accuracy scores of Group II systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam) in Group II courts.

5. There are statistically significant differences among mean transcription scores for transcribing systems (Baird Atomic, Dictaphone, GYYR, Sony and Tascam). This difference can be attributed to low mean scores of the Tascam machine on the Scheffé test. (See Table 11).

Recommendations

The comparative analysis of the data collected during this study and the experience gained, shows that certain changes should be made in the preliminary selection specifications for recording/transcribing systems for Missouri Associate Circuit Courts. Following is the list of new specifications and reason for their inclusion.

1. Headphones output for transcriptions with output loud enough to be easily heard over typewriter noises, to provide accurate and

non-distracting transcription. The Tascam machine, during the transcription test, showed a poorer score due to low playback volume on headphones. This can be easily altered in this system by providing more efficient headphones for greater volume.

2. Radio frequency suppression circuits and/or shielding guaranteed to not pick up radio frequency interference. The pickup of radio and citizen band interference with recording and playback at four times during the test showed the need for this specification.
3. 24-hour maintenance or replacement until repair. The system breakdown of all but one of the machines showed the necessity for this specification.
4. Foot control with automatic backspace at stop. Machine should automatically backspace at Stop during transcription to provide for accurate transcription. This specification is moved from the recommended to required features due to evidence of significant differences in the Tascam system at transcription. Most transcribers require

backspace at Stop to refresh their memories of what they have typed. When a footpedal has only fast rewind, it is hard to control to allow only a few words of backspace. The transcribers must then play back for a long period to search for the proper Stop position.

Following are the final specifications for recording/transcribing systems for Missouri Associate Circuit Courts.

Specifications for Magnetic Recorders/Transcribers for Missouri Associate Circuit Courts

1. Required Features

   a. Four-channel Record/Playback

      Four-channel recorders provide separate magnetic tracks for trial participants. Parties recorded speaking at the same time can be transcribed accurately and identified by selecting an individual channel or turning down a distracting channel.

b. Monitoring Facilities

Headphone and visual capability to monitor recording after record head through monitor or playback to insure that accurate recording is taking place and allow for adjustment of recording.

c. Four or more Low-Impedance Balanced Line Microphone Inputs.

One microphone input for judge, witness and each counsel. Balanced, grounded, low-impedance microphones and inputs insure against recording of ground loop noise or extraneous electronic signals.

d. No Erase Head

Machine must be incapable of erasing previously recorded testimony.

e. Indexing Capability

Machine must include an accurate indexing system for logging and later locating testimony for playback and transcription.

f. Record and Transcribe Capability

Unit should be able to record testimony and later be easily moved to act as a transcribing machine in low volume courts to minimize expense.

g. In-Court Playback Capability

Machine must include an amplifier and speaker for in-court playback.

h. At Least Three Hours Continuous Recording
Machine must be capable of at least three hours of recording without changing tape. Halting a trial for frequent tape change could be distracting to trial participants.

i. Tape Motion Indication and Security
Tape motion should be identifiable. Machine should stop automatically at end of tape or with a broken tape and give an audible warning.

j. Remote Foot Control for Transcription
Foot control should provide Play, Fast Forward, Stop and Rewind for easy transcription.

k. Selectable One to Four Channel Playback for Transcription
Transcriber-clerk should be able to select individual channels and alter volume for accurate transcription.

l. Headphones output for transcriptions with output loud enough to be easily heard over typewriter noises, to provide accurate and non-distracting transcription.

m. Radio frequency suppression circuits and/or shielding guaranteed to not pick up radio frequency interference.

n. Twenty-four-hour maintenance or replacement until repair.

o. Foot control with automatic backspace at stop. Machine should automatically backspace at stop during transcription to provide for accurate transcription.

2. Recommended Features

a. Signal Sensing Device

Machine should be incapable of recording over a tape of existing testimony to insure against accidental destruction of court records.

b. Lock-up Capability

Machine should be able to be locked to prevent possible tampering

Future Research

Future research should explore the following questions:

1. What are the skills necessary to effectively operate magnetic recording/transcribing equipment?

2. Will new equipment be significantly better in operating ease and recording quality?

3. What are necessary storage requirements for magnetic recordings of court proceedings?

4. What are effective magnetic recording and transcribing procedures?

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