A Practitioner's Primer on Computer-Generated Evidence

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Few, if any, inventions have had as great an impact on society as the "computer."¹ The computer has permitted and, if correctly understood and properly used, will continue to permit geometric progress in all fields of endeavor; the potential result is more efficient use and more equitable allocation of resources and great advances in science and industry. Used improperly, the computer could lead to a destruction of individual privacy and the ultimate police state.²

Although we are only at the dawn of the computer age, the computer has already affected virtually every aspect of our lives.³ As the use of the computer further develops, the impact of computerization on the legal profession will be widespread, reaching all facets of legal practice. The

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¹ "Computer" is a broad term that has little meaning when used alone. There are two general types of computers: analog and digital. The analog computer operates by measuring, whereas the digital computer essentially operates by counting. Analog computers are specialized machines that are generally used to control other machines or for scientific purposes. The vast majority of computers currently in use are digital computers; they are used in business, government, and other fields for "electronic data processing." Computers that combine features from both types are called "hybrid" computers. The term "computer" as used here refers to digital computers and includes electronic devices ("hardware") and the programs ("software") used to direct those devices.

² See generally *Hearings On Federal Data Banks, Computers And The Bill of Rights Before the Subcomm. on Constitutional Rights of the Senate Comm. on the Judiciary*, 92d Cong., 1st Sess. (1971); A. MILLER, *THE ASSAULT ON PRIVACY: COMPUTERS, DATA BANKS, AND DOSSIERS* (1971); U.S. DEP'T OF HEALTH, EDUCATION, AND WELFARE, *RECORDS, COMPUTERS AND THE RIGHTS OF CITIZENS, REPORT OF THE SECRETARY'S ADVISORY COMMITTEE ON AUTOMATED PERSONAL DATA SYSTEMS* (1973).

³ Computers were first used at the end of World War II, but their widespread use, particularly in industry, did not come until much later. Technological advances have reduced the cost of computerization by a magnitude of approximately ten every four years. Technological advances in electronics that have produced the "minicomputer" may decrease costs at a faster pace. The increased use of computers is revealed by the rapid increase in the number of government-owned computers. The federal government owned 2 computers in 1952, 403 computers in 1959, and 5,961 in 1971. See GENERAL SERVICE ADMINISTRATION, *INVENTORY OF AUTOMATIC DATA PROCESSING EQUIPMENT IN THE U.S.A., FISCAL YEAR 1971*, at 15A. Reportedly, the federal government now owns over 7,000 computers. Since current computers have far more computing power than the computers of only a decade ago, the actual increase in use is many times greater than these figures suggest. Industry uses computers for management and allocation of resources, accounting, regulation of credit, and assistance in planning and operating machinery.

profession will have to fulfill its historical role in balancing the use of developments in technology against individual rights and societal needs.⁴

Computers will have a significant impact in generating evidence for litigation; knowledgeable practitioners will use computers to prepare and present evidence that, without the computer, would be absolutely impossible to present or too costly to prepare. A major use of computers today is in generating and maintaining business records, and business records will probably be the most common source of computer-generated evidence.⁵ Beyond the business records situation, the computer also enables the litigator to place the world, or a relevant part of it, in a "computer test tube" to present evidence of his or her theories to the court. In the future, there is likely to be a substantial increase in the use of survey and statistical evidence analyzed by computers. This effort will naturally lead to further development of the law of evidence regarding surveys, public and private statistics, and similar data used to generate evidence.⁶

Although the computer has tremendous potential for improving our system of justice by generating more meaningful evidence than was previously available, it presents a real danger of being the vehicle of introducing erroneous, misleading, or unreliable evidence. The possibility of an undetected error in computer-generated evidence is a function

⁴ The legal profession is faced with computer-related issues such as the invasion of privacy from computer-maintained personal data files. See note 2 *supra*. The legal system will soon be asked to construct an adequate legal framework for computer-generated phenomena like the "cashless, checkless society." See generally Bigelow, *The Lawyer's Role in the Computer Age*, 1 *RUTGERS J. COMPUTERS & LAW* 1 (1970); Dunne, *The Checkless Society and Articles 3 and 4*, 25 *BUS. LAW* 127 (1968); Freed, *A Lawyer's Guide Through the Computer Maze*, 6 *PRAC. LAW.* 15 (Nov. 1970); Stiefel, *A Checkless Society or an Unchecked Society*, 19 *COMPUTERS & AUTOMATION* 32 (Oct. 1970).

⁵ All of the reported cases dealing with computer-generated evidence involve evidence taken from computer-maintained business records. Litigators will appreciate the ability to display the product of computer-maintained business records in a more meaningful manner than was possible with manually maintained business records.

⁶ The possible uses of the computer for generation of evidence are nearly unlimited. Given the proper statistical base and model, the computer might be used to prove or disprove a claim that a proposed acquisition will substantially lessen competition in some line of commerce in a section of the country so as to violate section 7 of the Clayton Act. 15 U.S.C. § 18 (1970). Computer data bank reports on sentencing might be used to support the contention that a harsh sentence for a crime, albeit within the statutory limits, constitutes "cruel and unusual punishment." Cf. *Furman v. Georgia*, 408 U.S. 238 (1972). In a criminal case built on circumstantial evidence, computer-maintained statistical evidence might be helpful in deciding whether there is "reasonable doubt" about the defendant's guilt. See generally Fairley & Mosteller, *A Conversation About Collins*, 41 *U. CHI. L. REV.* 242 (1974); Kingston, *Probability and Legal Proceedings*, 57 *J. CRIM. L.C. & P.S.* 93 (1966). The IRS's computerized index system has been used to determine whether a particular case was an isolated case in a nonrepetitive setting. *First Nat'l Bank v. United States*, 358 F.2d 625, 631-32 (5th Cir. 1966).

of many factors: the underlying data may be hearsay; errors may be introduced in any one of several stages of processing; the computer might be erroneously programmed, programmed to permit an error to go undetected, or programmed to introduce error into the data; and the computer may inaccurately display the data or display it in a biased manner. Because of the complexities of examining the creation of computer-generated evidence and the deceptively neat package in which the computer can display its work product, courts and practitioners must exercise more care with computer-generated evidence than with evidence generated by more traditional means. Only if courts and practitioners acquire a basic understanding of the principles of computerization and the use of computers can they effectively deal with and adequately use computer-generated evidence. To move towards this understanding, this article will explain, in basic terms, the underlying principle of the digital computer, suggest an outline for examining the worth of evidence generated by an electronic data processing system, and survey the present state of the law regarding computer-generated evidence.

I. THE "COMPUTER": THE SOPHISTICATED APPLICATION OF A SIMPLE PRINCIPLE

A. The Basic Principle

Although many people are discouraged by the apparent complexity of computers, the basic principle of the computer is quite elementary. The basic operating principle behind the computer, which this article will refer to as the "light bulb principle," is the following: when a device has exactly two conditions, each condition can be arbitrarily assigned a distinct value.⁷ For example, a light bulb is a device that has exactly two conditions; either it is on or it is off. The on light bulb could be assigned a value of "yes" or "1," and the off light bulb could indicate "no" or "0."⁸

The binary numbering system, which most of us have studied but repressed long ago, has only two digits or values—zero and one—and is based on powers of two.⁹ Although this system uses only zero and one,

⁷ If a device had three, four, or more distinct conditions, each condition could also be arbitrarily assigned a value. Devices with exactly two distinct conditions, however, are far more prevalent than devices with more than two distinct conditions.

⁸ In essence, we are talking about the long-recognized concepts of symbolism and symbolic language. To primitive man the sun and light represented good, and night and darkness represented evil. The symbolism of thumbs up representing satisfaction, and thumbs down representing dissatisfaction, has existed for thousands of years. All children know that the cowboy with the white hat is the good guy, and the cowboy with the black hat is the bad guy.

⁹ In translating values from the binary system to the decimal system, the order of the

it can be used to represent any number found in the more familiar decimal system, and all mathematical functions that can be performed in the decimal system can also be performed in the binary system. Numbers can also be used to represent letters. For example, we can arbitrarily set one equal to A, two can equal B, and so forth.

The fundamental attribute of the computer is its ability to store in its memory a substantial amount of data and to retrieve and operate on that data with fantastic speed. The computer gets this memory capacity simply by combining the light bulb principle with the binary numbering system. Five light bulbs in a row constitute a primitive memory unit that, using the binary system, is capable of storing and indicating any number up to 31.¹⁰ This storage device could also represent any letter in the alphabet if we assigned each letter a different numeric value. This process is "coding" the information to fit the storage device. With three separate light bulb storage devices, two with five bulbs and one with six, it is possible to approximate, in a very inefficient manner, the operations of a computer. For example, one could read the numbers stored in the five-bulb memory units, add those numbers together, and store the answer in the six-bulb device for later reference.

Actual computers contain millions of storage devices, and the number of external storage devices is virtually unlimited.¹¹ A number of different devices, all of which have exactly two distinct conditions, are used as internal and external storage devices: the more common memory devices include punch cards,¹² punch tape,¹³ magnetic core,¹⁴ magnetic tape,¹⁵

digits determines which power of two is used in determining the value of the digits. The digit farthest to the right is multiplied by 2 to the zero power; the next digit to the left is multiplied by 2 to the first power; the next digit to the left is multiplied by 2 to the second power; and so forth. For example, the binary number 1011 (read as "one-zero-one-one") equals 11 in the decimal system. It is translated to its decimal equivalent as follows:

$$\begin{aligned}(1) \times 2^3 &= 8 \\(0) \times 2^2 &= 0 \\(1) \times 2^1 &= 2 \\(1) \times 2^0 &= 1 \\ \hline &11\end{aligned}$$

¹⁰ If all the lights were on the number 31 would be represented:

$$(1) \times 2^4 + (1) \times 2^3 + (1) \times 2^2 + (1) \times 2^1 + (1) \times 2^0 = 31.$$

More generally, n bulbs are capable of representing any decimal number up to $(2^n - 1)$.

¹¹ Each storage device contains one binary digit, a one or a zero, and is referred to as a "bit." A memory device—a collection of identical storage devices—with a 10,000 bit capacity can retain 10,000 binary digits.

¹² The presence or absence of a hole in the appropriate field indicates either a one or a zero. The most common punch cards have a ninety bit capacity. Although punch cards remain the most common medium of external storage, they are bulky, cumbersome to handle, slow to transfer, and subject to loss and destruction. Consequently, the importance of punch cards as an external storage medium will diminish.

¹³ Again, the presence or absence of a hole indicates either a one or a zero. Punch tape is also a relatively primitive external storage device, but it is somewhat easier to handle, and

and magnetic drum.¹⁶ The efficiency of a memory device is generally measured in terms of the speed with which data can be stored or retrieved; this speed is partly a function of the device's ability to store data in a compact form.¹⁷ Major technological advances have been made in developing new memory devices, resulting in reduced cost of computerization and great improvements in storage capacity and operating speed.¹⁸

B. The Basic Components

With this memory capability, the operation of a computer system¹⁹ is generally performed through five basic components: input devices, programming, the central processing unit, external storage, and output devices. These components perform the five basic functions of computerization: input, processing, control, storage, and output.

An *input device* is any device used in entering data into the computer system. It translates data into signals that the computer understands. The different types of input devices include card readers, magnetic tape units, paper tape readers, magnetic-ink character readers, optical scanners, console typewriters, on-line data collection devices, and remote terminals. A computer user has some options as to the type of input de-

less likely to be destroyed or lost, than a punch card. It does not, however, have the "sortability" characteristic of cards.

¹⁴ A magnetic core is a small ring of material that can be magnetized in either of two directions to represent one or zero. Magnetic core is most commonly used as internal storage in the central processing unit.

¹⁵ Magnetic tape is tape coated with magnetic material on which digits can be represented by the presence or absence of spots. Magnetic tape can have a capacity of over 20 million bits per tape and can be transferred at rates of more than 350,000 bits per second.

¹⁶ A magnetic drum is a rotating cylinder that is coated with magnetic material so that magnetic spots can be arranged around the cylinder as bits. Magnetic drums have a capacity of up to four million bits per drum and a transfer rate of more than 1.2 million bits per second. Magnetic strips, found on the back of many credit cards, can store over 4 million bits and can transfer more than 45,000 bits per second.

¹⁷ The elapsed time between a request for stored data and the start of delivery of that information, or between a request that data be stored in a memory location and the start of storage, is referred to as "access time." The access time of modern computers is measured in "nanoseconds," each equalling one billionth of a second. Other important characteristics of storage devices include the cost per bit ratio and the susceptibility of the device to destruction or error.

¹⁸ The storage capacity of the IBM 370, representative of the current generation of business computers, is 700 times that of the Univac I, the first commercial computer. The IBM 370 also executes additions 4,300 times faster, multiplications 3,100 times faster, and divisions 2,000 times faster than the Univac I. Technological advances in the memory area since the Univac I have increased the cycle speed of main memory devices by a factor of 1,000 and the data transfer rate of current tape drives is more than 40 times that of the earliest tape drive used in the Univac I.

¹⁹ The term "computer system" as used herein includes all mechanical and electrical devices used for processing the data ("hardware") as well as the programs ("software") used to instruct those devices.

vice to be used, but the nature of the input, the type of central processing unit, the available storage equipment, and other factors play a role in determining the appropriate input equipment. The most important characteristics of input equipment are speed of entry, primary error detection, and minimization of human intervention. The lawyer's primary concern with input devices in considering computer-generated evidence is the tendency of the device to introduce or eliminate error in input.²⁰

Programming is a formulation supplying to the computer a logical sequence of step-by-step operations for the solution of a particular problem.²¹ For two reasons, a basic understanding of the programming component is vital for the practitioner faced with a computer-generated evidence issue. First, the program controls the computer. The computer can only operate on the data that the program instructs it to operate on and can only perform the operations that the program directs it to perform. If there is an error in the program, the computer obediently commits that error, possibly many times. Second, the program is a com-

²⁰ As a general proposition, as the amount of human intervention required in the input process increases, the probability of the introduction of error increases. Input devices, and the procedures employed in utilizing them, can be designed to detect errors in the raw data and prevent the introduction of error into the input process.

²¹ Programs are written in a "program language," that is, an intermediate step between the spoken language and the binary language recognized by the computer. Through "assembly" and "compiler" programs, the program is converted from its intermediary language to machine language. There are essentially four language levels. The lowest level is machine language, which is an absolute binary language understandable by the machine but not intelligible even to trained humans without a great deal of computation. The next highest order is symbolic language, in which a symbolic instruction translates into a machine language instruction; for example, "ADD" might be the symbolic code for addition. In symbolic language, memory locations are referred to by symbolic names instead of actual location numbers. When the assembly program converts symbolic coding into absolute instructions, it usually performs simple checks to detect errors in coding. The next language level is symbolic language utilizing macro-instruction. Macro-instructions are coded instructions for performing common logic operations; in the translation process an assembly program interprets each macro-instruction as a specification calling for a set of instructions, rather than a simple one-for-one translation, thus eliminating a great deal of detailed coding. The highest level, used in most business programs, is procedure- or problem-oriented language. It is usually written without reference to the computer on which it will be translated. English words and common mathematical notations are used to describe the processing steps. Examples of such languages are Fortran (Formula Translator) and COBOL (Common Business Oriented Language); report program generators (RPG) are frequently used in business applications.

Each level of programming language has its advantages and disadvantages. Lower language level usually requires less running time, but higher level languages are easier to use, reduce programming time, and can be used with different computers. In addition, the higher level languages are partially self-programming because of their understandable terminology. The general trend is towards using higher order languages; as computers become more efficient, higher order languages will probably approximate the English language, thus significantly reducing programming difficulty and increasing machine running efficiency.

position; it is a set of instructions and, more than any other component of the computer system, reflects the skills and creativity of an individual or individuals. A program is often written for a specific application and thus is not entirely duplicated elsewhere. A program can be tested, and there is always a "debugging" process. A properly written program, however, must be equipped to handle every contingency arising from the data being processed. As the data and the operations to be performed become complex and voluminous, the program becomes more complex, and the ability to obtain complete verification that the program is actually able to deal with all possible contingencies is consequently reduced. Many programs are therefore not susceptible to complete testing.²²

A single computer application usually involves several programs. There is normally a controlling or primary program used for a particular application. The practitioner working with computer-generated evidence must look to this program first, and he must give it his greatest attention. The controlling program typically uses a series of subordinate programs that are frequently used for a number of different applications.²³ The probability of error in a subordinate program is far less than in the principal program, because subordinate programs are relatively simple and repeatedly used. There is a possibility, however, that the primary program may call in the wrong subordinate program and that the data will therefore be improperly processed.

Writing a computer program is an exercise in logic²⁴ in which every

²² The hardware is usually susceptible to complete testing, both at the time of assembly and on site, since these components are rarely unique. Thousands of units of the same component may be built and then sold to a diverse group of customers for a wide range of applications. It is therefore unlikely that a design error in hardware would remain undetected for a substantial time.

²³ These programs, sometimes called "routines" or "subroutines," are normally maintained within the computer's memory system. They often involve repetitive input, output, and logic functions and are called in by a special code. Manufacturers often provide subroutines for common tasks such as calculating square roots, generating random numbers, and multiplying and dividing. (Some computers do not have hardware equipment for multiplication and division but perform these functions through multiple additions and subtractions.) Simulator programs allow one computer to simulate the performance of another computer, thus permitting the user to run an old program on a new computer without rewriting the program; simulator programs are also used to test new computers with old programs before installation.

²⁴ Attorneys are conditioned to think at a rather high level of abstraction; programming is a stark contrast to this process. For example, an attorney would tell a person sitting in his or her office to close the door by simply saying, "Close the door." If that person were a computer, however, it would have to be programmed somewhat as follows: (1) Place left foot on floor. (2) Place right foot on floor. (3) Bend body forward. (4) Straighten spine. (5) Turn 160 degrees (this instruction would take an entire series of sub-instructions). (6) Place right foot in front of left foot. (7) Place left foot in front of right foot (etc. until the door is reached). (8) Place right hand on doorknob. (9) Turn doorknob clockwise 20 degrees.

process is broken down into its most basic elements. The programmer must have a thorough understanding of the problem to be resolved, the data to be processed, the type of operations to be performed, and the type of output desired.²⁵ The programmer's failure to understand any of these aspects will, at a minimum, result in inefficient utilization of the computer and increase the probability of error. After the programmer understands the problem and data, he or she designs the input format, programs, and output format in a series of steps using flow charts and layouts of reports, documents, records, and the like.

After the program has been written and errors ironed out (the program "debugged"), complete "documentation" should be made. A manual should be prepared that includes the procedures to be followed in processing data, the flow charts, the program, and computer operating instructions. The practitioner working with computer-generated evidence should consider the documentation as a primary source document, and one of his first concerns should be that the documentation is complete and accurate.

The *central processing unit*, or *CPU*, is the heart of the computer system. The CPU contains the control unit, the arithmetic and logic unit, and the primary storage. The control unit guides the computer. Following the instructions in the programs given to it, the control retrieves the required data and directs the logic unit to perform the necessary functions on that data; it then either returns the data to the appropriate memory location or outputs the data, or both. The control unit is the closest thing in the computer to a brain. The control unit, however,

(10) Push door to jamb. (11) Stop pushing door when it reaches jamb. (12) Remove right hand from door. (13) Remove right hand from doorknob.

Even these instructions are not as detailed as they should be; for example, our friendly computer is left facing the door with a blank look on its face, because we have not given it the instructions for returning to its seat. But they do provide some insight into the stupidity of the computer and the extreme detail required in programming. If one step in the process is missed, the computer will not perform correctly the desired operation. In the above example, if we did not tell the computer to stop pushing the door when it reached the jamb, the computer would not go to the next instruction; it would instead continue to push the door until someone pulled out its plug.

²⁵ A substantial communication gap between business managers and computer managers is common. This gap is partly the result of the mystique that surrounds computers; science fiction writers have portrayed them as taking over the world, while others have simply portrayed them as taking over everyone's occupation. People working with computers have developed their own mysterious language that adds to this mystique and shuts the rest of us out of their domain. As a gross overgeneralization, business managers are usually in the older generation; they do not understand, or say they do not care to understand, the computer. The computer managers generally are of the younger generation and, all too often, do not understand the needs of the businesses they are supposed to serve. The resulting lack of communication has been responsible for a great deal of computer error. Hopefully, this phenomenon is transitional and will disappear with the maturing of the computer age.

must be told the location of the next instruction to be executed, the location of the data to be processed, the operations to be performed, the storage location in which the resultant data is to be placed, and so forth. The arithmetic and logic unit might be compared to a desk calculator. It can add, subtract, multiply, divide, and make comparisons; it can also implement logic and shifting functions.²⁶

The primary storage component of the CPU is a memory device within the CPU. To increase machine operating speed, necessary data is obtained from secondary storage and placed in primary storage while being processed; after processing, it is returned to secondary storage or outputted.

Data is stored outside of the CPU in the *external storage*, or secondary storage. There is a wide variety of available external storage devices,²⁷ and secondary storage may be maintained with a combination of these devices. Some types of secondary storage use space more efficiently than others or have faster retrieval times. The primary concern of the practitioner, however, is the integrity of the external storage devices and procedures. For example, a punch card can be lost, or a magnetic charge on a tape can be concealed by dust. The practitioner should determine that the secondary storage procedures contain adequate safeguards against the introduction of error or loss of information.²⁸ As advanced technology reduces access time to data in secondary storage, the distinction between primary storage and secondary storage may become less meaningful.²⁹

Output devices receive the data from the CPU and, in many instances, translate it into an intelligible form and display it.³⁰ In many instances, such as typewriter terminals, the input device is also an output device. Occasionally, a visual output is given on a cathode ray tube; recently de-

²⁶ Little logic is designed into the logic unit itself, because to do so would limit the flexibility of the machine. A major strength of the digital computer, however, is its ability to perform complex operations by breaking them down into a sequence of simple operations. By repeatedly performing simple operations in different combinations at a fantastic speed, the computer can resolve complex problems with almost incomprehensible speed.

²⁷ See text and notes at notes 12-16 *supra*.

²⁸ In the case of punch cards, batch controls can be used. The loss of a magnetic charge from a tape can be detected by the use of circuits that count the bits on each stored binary number then check this against "parity bits" placed on an extra channel along the magnetic tape. See note 41 *infra*.

²⁹ Primary storage is also referred to as addressable storage. One measure of the computer's power is its primary, or internal, storage capacity. If a computer user employs a CPU with an inadequate addressable storage to perform required functions, he or she may have to eliminate safeguards to process the data.

³⁰ Not all output devices translate the data into a form comprehensible to humans. The output device often transfers the computer output onto a medium than can later be reprocessed or translated into intelligible form.

veloped output devices, known as computer-output microfilm devices, produce microfilm. The most frequently used output devices are printers that generate "hard paper" output, such as computer reports, bills, mailing lists, and so on.³¹ Since the output component presents the least likelihood of error being introduced into computer-generated evidence, the practitioner should be less concerned about it than the other components.

II. A SUGGESTED ANALYTICAL APPROACH TO COMPUTER-GENERATED EVIDENCE

Three fundamental principles must always be remembered when analyzing computer-generated evidence. First, *the computer can only process the data given to it*; if that data is in error and the error is undetected, the output will be in error. Second, *the computer can only process the data it is instructed to process*; if that data is incomplete or inaccurate, the output will be in error. Finally, *the computer can only process the data as it is told to process the data*; if there is a deficiency in the manner in which the computer is told to process the data, the output will be in error.³²

It is submitted that the most appropriate manner of analyzing computer-generated evidence is to trace the path of the underlying data from its original generation and assembly through each stage of the "electronic data processing system"³³ to its final form as computer-generated evidence.³⁴ The practitioner should visualize the data as flowing from its source through the electronic data processing (EDP) system to its final destination as evidence; he or she should then trace what happens to that data as it works its way through the system. The practitioner should resist the temptation to begin the analysis with the computer-generated

³¹ Mechanical impact printers operate at up to 2,000 lines per minute, while electrostatic printers, using a principle similar to copying machines, can operate at even higher rates. There are also special purpose printers to produce graphs, charts, drawings, and maps.

³² The probability of the mechanical component of the computer system committing an undetected error is negligible. Internal tests constantly monitor the equipment to ensure that there is no electrical or mechanical malfunction, and there are external programs that can be used to detect equipment malfunction. The biggest danger of equipment malfunction comes from a disruption of electrical service either in the form of inadequate power or a power surge that damages the circuitry. When power is cut off, semi-conductor circuits may lose or "scramble" stored data. Most computers are equipped with devices that shut down the computer when the power supply varies from acceptable levels.

³³ This term is here defined as every process and operation that the data passes through from its initial generation and collection to its final representation and use in an intelligible form. In addition to the computer system discussed above, it includes the personnel and human procedures used in processing the data.

³⁴ The analytical process is basically the same for both the proponent and the opponent of the evidence, since they share the common goal of assuring the trustworthiness and accuracy of the data generated by the computer.

evidence itself and work backwards through the electronic data processing system. Such an analysis may prevent the practitioner from following the natural "flow" of the data, thus leading to blind spots and hiding the logic that is basic to the electronic data processing system and is extremely helpful in the analysis of computer-generated evidence.

In analyzing computer-generated evidence, data passing through an electronic data processing system can be considered to pass through five stages—generation and assembly, input, operation, storage and retrieval, and output. These five stages do not represent a definitive breakdown of all the stages through which data might pass. In some cases the stages might be combined or not occur in the order indicated, or data might pass through the same stage several times before reaching its final form. These five stages do, however, provide an adequate analytical outline with which to test computer-generated evidence.

A. Data Generation and Assembly Stage

The initial stage of the EDP system encompasses generation of the underlying data and collection of that data for inputting. The greatest likelihood of introducing error into computer-generated evidence lies in the data generation and assembly stage.³⁵ This stage is also important because the answers to the best evidence and hearsay problems lie here. The following questions should be investigated regarding the data generation and assembly stage.

1. *What is the true source of the data?* This question can be quite difficult to resolve. Frequently there are quick but false answers to this inquiry, and the practitioner must be alert to be certain not to arrive at an erroneous conclusion. For example, if the evidence in question is a company's computer-generated accounts receivable ledger, the data may appear to come from the invoices that were prepared when the goods were shipped to customers, because the data was inputted to the computer system at that time. Further investigation might reveal, however, that the data on the invoices was actually transferred from a purchase order. Moreover, that data might have come in oral or written form, from either the customer or a company salesperson.

2. *What processes does the original data pass through in the generation and assembly process before arriving at the input stage?* Generally, the more processes—that is, the more handling by humans—that the data passes through before arriving at the input stage, the greater the probability of error. Each time human intervention is required to trans-

³⁵ At this stage the "computer world" meets the "other world." The downstream procedures for generating and collecting data have often not been modified for computerization; the "pre-computer" procedures are still being followed, which can be a source of difficulty.

fer or translate data, the problem of introduction of error is presented. Everything else being equal, the probability of error being introduced into data that is handled many times by humans prior to arrival at the input stage is significantly greater than the probability of error for data that is handled only once.

3. *What steps are taken to detect error in the original data and prevent the introduction of error into, or loss of, that data as it passes through the generation and assembly stage?* A response to this broad question requires an analysis of both people and procedures. Adequate supervision and employment of competent personnel in the data generation and assembly stage is obviously important.³⁶ An analysis of the procedures used in generating, collecting, and verifying the data is critical. A well-designed data processing system includes safeguards to prevent generation of incorrect data, introduction of error into the data, and loss of data. As discussed below, appropriate data verification and test procedures should be incorporated in every stage of the electronic data processing system.

4. *What hearsay or best evidence problems, if any, are suggested by the underlying data?* At this point in the analysis, it is necessary to consider and resolve these problems.³⁷

5. *What has been the prior experience with the data collection and assembly procedures?* This inquiry can be extremely helpful to the practitioner. The response will show weaknesses and strengths of the process and suggest further areas of inquiry.

B. Input Stage

In the input stage the assembled data is prepared for entry and entered into the computer system. The input devices discussed above are used in this stage. As a general proposition, the closer the input stage is in time

³⁶ The individuals employed at this stage typically are low-paid clerical personnel who have a high turnover rate and low motivation. Moreover, their jobs are normally quite tedious, and their interest in their work is often minimal. Indeed, these people will probably be the next class of individuals to be replaced by computerization. It should be noted, however, that the computer is only capable of replacing people performing mundane and repetitive tasks.

³⁷ The hearsay issue perhaps should be included in the inquiry into the true source of the data. With respect to the best evidence problem, the practitioner will often find that the original source document, if it was a "hard document," has been destroyed. One of the advantages of computerization is the ability to maintain records in a compact form, instead of bulky paper records. In more advanced computer systems, data is inputted directly into the computer and no paper record is ever generated. This procedure results in the loss of external audit trails and makes evidentiary problems more difficult. For a discussion of the hearsay and best evidence questions, see text and notes at notes 48-78 *infra*.

and space to the original generation of the data, the lower the probability of error being introduced into the data at either the data generation and assembly stage or the input stage. There is a trend towards input devices that pick up data either from the original source document³⁸ or at the moment it is generated.³⁹ The efficiencies inherent in such devices make it inevitable that they will become more prevalent.

The distinction between the data assembly and data input stages is hazy and will become less clear with advancing technology. As a result, some of the general inquiries suggested for the data generation and assembly stage are also valid for the data input stage. Some of the relevant questions the practitioner should ask concerning the input stage follow.

1. *What types of input devices are used?* The types of input devices used must be ascertained to assess the possibility that error has been introduced in the inputting stage or that the data has not been completely inputted. Only by learning the types of input devices used can the practitioner determine the appropriate direction and scope of his inquiry into the input stage. The probability of error varies directly with the amount of human involvement in the particular inputting process. For example, the key punch system, all other things being equal, has a much higher probability of introducing error or losing data than an on line system that records the data as part of the original transaction.⁴⁰

³⁸ For example, character recognition devices such as those used to read the characters encoded on the bottom of checks.

³⁹ An example is the new cash register systems and charge card terminals that, at the time of the consummation of the transaction, input into the computer system all relevant information concerning that transaction. To input data from a old manual cash register system required manual inventory, processing of sales receipts, and so on; with the direct access cash register system, the computer instantly knows when an item is sold and is thus able to generate inventory reports, sales reports, cash receipt reports, reorder reports, and the like. A further advancement now coming into use is the "magic wand." This system uses a device attached to the cash register that automatically reads a precoded series of symbols on the merchandise. The computer then uses that code to determine the price of the product, previously programmed into the computer, and automatically includes that price on the sales tape, as well as recording the transaction for generation of inventory, cash, and other records. This process will greatly speed up checkout, reduce or eliminate the possibility of error in ringing up sales, and, properly used, contribute to management efficiency. It can also make the retailing industry more efficient by reducing manpower requirements and permitting more advantageous inventory control. The possibility of error is minimized, since little, if any, information is inputted by humans.

⁴⁰ In a key punch-key verifier system, the data is first recorded on some form of hard record and then manually taken from that record and punched into a computer card. In fact, the data may be manually transferred many times before it reaches the key punching stage. Realizing that a key punch operator might, in the course of a monotonous seven-hour day, transcribe thousands of pieces of data about which he or she has little knowledge or interest, it is not difficult to appreciate the possibilities of errors being introduced into the data. The possibility remains even with key verification, an operation that entails repunching the same card from the same information.

2. *What procedures are used for error detection?* The practitioner should be aware that there are standard practices for error detection for the various types of input devices. For instance, in the case of card punch input, it is standard to use a card verifier, batch control,⁴¹ footing control, and so forth. If the error detection and verification procedures in the system being considered do not coincide with industry practices, the matter should obviously be pursued further. The practitioner should not be satisfied with proof that the systems manual prescribes apparently adequate error detection verification procedures; he or she should determine whether those procedures are actually used.

3. *Is the input operation performed in multiple locations?* It is not unusual for input operations to be performed in multiple locations, for example on remote terminals or by key punching in branch offices. If this practice is followed, the practitioner should make two inquiries: whether the error detection and verification procedures are uniformly followed at all locations; and whether, in assembling the data in its input form, adequate precautions are taken against the undetected loss of data. These questions are particularly important for key punch cards generated from multiple sources. Batch control procedures are a simple and effective means of preventing such data loss.

C. Operation Stage

In the operation stage the data is operated on by the computer; calculations are performed, and the data is merged, stored, retrieved, and so on. This stage involves both the hardware (CPU and support equipment) and software (programming) components of the computer system. The operation stage is extremely critical and difficult to evaluate without expert assistance. Some of the relevant areas of inquiry are the following.

1. *Is the CPU and related equipment, and the configuration in which they are being used, appropriate for the application?* If the hardware under consideration, or the configuration in which it is being used, is not generally used for the type of processing being performed, the computer system might not be suitable for that application. This problem is particularly dangerous if the computer equipment being used is less

⁴¹ The term "batch control" refers to a verification process in which some form of control test is run on the data universe to verify its completeness. For example, if a deck of punch cards reporting the cash receipts for one day were generated at a store, the batch control might consist of adding the dollar sales figure reported on each card in the deck. Suppose that dollar total was \$10,000. When the cards arrived at the EDP center, the sales figures on each card would once again be added to make certain that they totaled \$10,000. If they did not total \$10,000, further steps would have to be taken to determine what cards were missing. The difference between the control total generated at the store location and the EDP center would indicate the value of the sales reported on the missing card or cards.

powerful than the computer equipment generally used for the application in question.⁴² In addition, when the computer equipment is new and not yet in general use for the application in question, the likelihood of programming errors is increased.

2. *Are the personnel in charge of the EDP equipment competent to operate that equipment, aware of the peculiarities of the data they are working with, and knowledgeable about the requirements of the users of the output?* A substantial amount of misuse and error in EDP systems can be attributed to the lack of adequate communications between the electronic data processing managers and the business managers. If the EDP managers are not competent to operate the equipment, familiar with the data, and aware of the needs and requirements of the users of the output, the chances for error or other inadequacies in the generated data are increased. The practitioner should inquire into the length of time the EDP manager and other key data processing personnel have been with the company, their supervisory practices, their knowledge of the data, the equipment and programs they are using, and the business's data requirements.⁴³

3. *Is there adequate documentation?* Documentation includes programs, flow charts, operating procedures, and the like. The mark of a good EDP manager is the maintenance of adequate and current documentation for all data processing operations. If the documentation does not describe all programs used, give all flow charts, show all procedures, and so forth, it could be an indication that the EDP manager is also remiss in other areas. Adequate documentation is an excellent source for the practitioner conducting the analysis suggested in this paper; properly prepared documentation traces the data from its generation through the stages described in this analysis and describes the procedures used to assure accuracy and completeness of the data. The practitioner

⁴² Small banks that have prematurely tried to do their own EDP work provide excellent examples of the use of underpowered computers. Because of financial restrictions, such banks are often forced to use CPUs that lack sufficient internal storage capacity to operate on the type of programs necessary in performing bank EDP functions. To make ends meet, banks in this position have been known to delete audit trails and verification test procedures, thus reducing the internal memory requirements to the point where the computer could be used to process the bank's work, albeit not in a satisfactory manner.

⁴³ The individuals operating the data processing equipment should at least be familiar with the programs being used. Computer manufacturers do make available "stock programs" for repeated applications such as banking, payroll, and other bookkeeping applications. Although these programs are usually relatively efficient, they are not tailored to the individual needs of the user. There obviously are problems when less than qualified data processing managers use such programs verbatim or try to modify them to suit their needs without first understanding the underlying program.

should determine, however, whether the documentation is actually followed and referred to in the day-to-day operations.

4. *Do the programs do what they are supposed to do?* This question is critical because the computer can only do what the programs tell it to do. If the programs are in error, incomplete, not designed to process all of the data that might be generated, or lacking appropriate verification and test procedures, errors in the output will result. In all but the simplest cases, the practitioner will require the assistance of an expert in this area. Frequently, the practitioner's client will be able to provide this expert assistance from its staff. If the practitioner has misgivings about the advice he is receiving from this source, he or she can seek independent advice, which is readily available from computer consulting services. There are a number of issues that should be raised about the program.⁴⁴

First, it is important that the programs provide for every contingency that might result from the data. The programs should at least be written so that, if the computer encounters data that it does not know how to process, that data will be flagged instead of processed in an erroneous manner. It is also necessary that the programs contain adequate verification procedures and generate audit trails.

Next, it should be determined whether the programs call in all the required data. If the programs are not designed to call in all data needed to generate the information sought, that information will obviously be incomplete or otherwise in error. Further, the programs should be able to distinguish between different items of data. For example, using names alone to identify individuals is inadequate, because of the possibility of duplicated names or of the same individual reporting under different names.⁴⁵ In addition, the program must be constructed to discriminate

⁴⁴ Because of the proprietary nature of some computer programs, the inability to patent them, and the inadequacy of copyright protection, confidentiality issues may be raised in response to discovery requests for documentation and programs. Adequate protective orders, however, should obviate this problem. If computer equipment is available that is comparable to the equipment on which the programs were operated, the practitioner should consider a test operation of those programs to determine the validity of the programs. See generally BOARD OF EDITORS OF THE FEDERAL JUDICIAL CENTER, *MANUAL FOR COMPLEX AND MULTIDISTRICT LITIGATION* ¶ 2.615 (as revised May 18, 1970). Moreover, if a party opposing the introduction of computer-generated evidence has access to comparable equipment and obtains discovery of the underlying programs and data, he or she can create output programs and cause the data to be outputted in the format most favorable to his or her case. The data could also be analyzed in a manner different from the opponent's program.

⁴⁵ The social security number is often used as an identifier. Alternatively, a table might

between different categories of input. For instance, in a bank application, the program must be able to discriminate between deposit and withdrawal items.

Obviously, the program must be able to perform the proper mathematical calculations. Without this ability, the data output will be erroneous. It is equally important that the program contain the correct values on which to perform these operations. Programs frequently contain values or call values from storage. For example, in computing FICA and federal withholding taxes, the appropriate values are usually incorporated in the program. If these values are wrong, the output will be wrong.

A final concern, involved in all of these aspects of the programs, is whether the program is current. Data input, management requirements, underlying facts, and EDP applications are rarely static. Adequate programming therefore requires that the programs be updated to adjust for changing conditions. The documentation should indicate whether and how a program is periodically updated.

D. Storage and Retrieval Stage

Data might go through the storage and retrieval stage several times during processing. Data normally go into storage immediately after being inputted, and each piece of data is retrieved from storage each time it is processed by the CPU; after processing, the data will frequently be returned to storage. The practitioner's primary question concerning storage and retrieval aspects of the EDP system is whether those functions are carried on in a way that protects the integrity of the data; to a significant extent, this protection is a function of the programming. It should be noted that data is most likely to be lost in older, bulkier types of storage systems, such as punch cards. The primary questions the practitioner must ask about this aspect of the system follow.

1. *Are the storage and retrieval procedures adequate to insure that data will not be lost, changed, or incompletely retrieved and that erroneous data will not be retrieved?* The scope and precise direction of this inquiry depends on the types of data storage devices used. There are standard procedures for assuring the integrity of each type of storage device, and it should be determined whether those procedures are in fact used.

2. *Are there adequate safeguards to prevent tampering with the data?* This problem will rarely arise, but the practitioner should be aware that

be built into a computer to test an individual's name against his or her address to make certain that it is the appropriate individual.

a person knowledgeable about the EDP system could, unless proper internal controls are maintained, tamper with the data and thus introduce error that might not be detected by the system's normal safeguards.⁴⁶

E. Output Stage

The final stage for purposes of this analysis is the output stage. The output stage includes the generation of the final product in an intelligible form and the use of that product. The computer will only output the data it is instructed to output and will output that data only in the format it is instructed to use. The following inquiries should be made regarding the output stage.

1. *Does the outputting program cause the computer to generate all relevant information in a valid format?* The answer to this question requires a return to the programming stage to determine what the computer has been programmed to output. The practitioner should realize that the computer can easily be programmed to suppress unfavorable information or to present information in a biased manner.

2. *Does the output generated for evidentiary purposes differ from the output generated for normal business use?* The output generated for litigation may differ in format or content from the output generated in the normal course of business. The practitioner should analyze all variances between the output for litigation and the normal business output; he or she should be satisfied about the reasons and legitimacy of those variances. In some cases, such variances will be a factor in determining what weight should be given to the evidence.

3. *For what purpose is the output used in the normal course of business and what reliance is placed on that output by the people who use it?* The normal use of the output may be relevant to the business records exception to the hearsay rule; it will at least be relevant to the weight of the evidence. Both the proponent and opponent of computer-generated evidence should be concerned about whether the individuals for whose use the data is generated in fact use that data for its intended purpose and have confidence in the integrity of the data.⁴⁷

⁴⁶ For example, accountants deliberately introduce into the system erroneous data (analogous to tampering with stored data), unannounced to the EDP managers, to test the validity of the programs, procedures, and internal controls. There have been cases of fraud in which business managers have deceived their accountants, creditors, and stockholders by understating their accounts payable through the simple device of removing a substantial number of the punch cards representing the accounts payable ledger. When controls are inadequate and it is impossible to verify unknown accounts payable, this scheme might work quite well for a time.

⁴⁷ There are many possible reasons for the recipients of computer output to fail to use

4. *For what period of time has the output been relied on and in what form?* The longer the output has been generated and relied on, the more weight it carries as evidence. The history of changes in format may also be informative.

III. OVERVIEW OF THE LAW

The courts are just beginning to face the issues raised by computer-generated evidence. No specific evidentiary tools have been developed to deal with this type of evidence, and the courts are trying to deal with the problems of computer-generated evidence through the existing statutory and common law rules of evidence. Several commentators and jurists have maintained that the existing concepts are adequate to deal with the phenomenon of computer-generated evidence.⁴⁸ Whether in practice these concepts are sufficiently flexible to accommodate this phenomenon, and whether jurists and practitioners are sufficiently resourceful to deal with the opportunities and challenges of computer-generated evidence, remains to be seen.⁴⁹

A. Statutory Rules

Computer-generated evidence will inevitably be hearsay, and to be admissible the evidence must therefore be brought within an exception to the hearsay rule. In most cases, the computer-generated evidence will arguably be either business records or generated from business records; as a result, the development of the law has been primarily in the area of the business records exception to the hearsay rule.⁵⁰ The Federal Busi-

and rely on that output, not all of which are related to the integrity of the output. Some people resist relying on anything generated by the computer because they do not understand it and feel threatened by its presence. In addition, it is not uncommon to find the computer generating useless reports because either the reports' function has become obsolete or the reports were never functional.

⁴⁸ See, e.g., *D & H Auto Parts, Inc. v. Ford Marketing Corp.*, 57 F.R.D. 548 (E.D.N.Y. 1973); Brown, *Electronic Brain and the Legal Mind: Computing the Data Computer's Collision Course With Law*, 71 YALE L. J. 239 (1961); Freed, *supra* note 4.

⁴⁹ As indicated by the suggested approach to computer-generated evidence, the discovery process, pretrial exchange of information, and resolutions of differences regarding intended offers of evidence may be more important in the case of computer-generated evidence than in the usual evidentiary situation. A party intending to introduce computer-generated material into evidence should be required to announce such intentions long before the trial, and the opposing party should be allowed to review the material necessary to conduct the above outline analysis. The Federal Rules of Civil Procedure are sufficiently broad and flexible to handle the discovery issues and document protection requirements arising in computer-generated evidence situations. See FED. R. CIV. P. 34 & 45. The procedures and recommendations contained in *Manual for Complex and Multidistrict Litigation* about computer-generated evidence, survey evidence, and summary evidence are also useful. BOARD OF EDITORS OF THE FEDERAL JUDICIAL CENTER, *supra* note 44, at §§ 2.614-2.617.

⁵⁰ It can be anticipated that in the future the computer will increasingly be used along

ness Records Act⁵¹ represents a significant expansion of the traditional "shop book" rule⁵² and can be applied to computer-generated evidence either taken from or representing business records. The general requirements for admissibility under this Act are (1) that the record was made as a record of an act, transaction, occurrence, or event in the regular course of business, and (2) that it must be in the regular course of that business to make the record at the time of the act, transaction, occurrence, or event.⁵³ The requirements of the Uniform Business Records As Evidence Act, now adopted by a majority of the states, are substantially the same.⁵⁴

with an expert witness to analyze data not taken directly from business records. Such information may, however, come indirectly from business records or from records, such as Commerce Bureau reports, maintained by government agencies in the normal course of government business. There may be pressure to expand the business records exception to cover this type of situation. When the computer is used along with an expert witness, there may be a tendency to discount the importance of analyzing the computer's role in generating the evidence; this temptation should be resisted, and the analysis should be as vigorous as where evidence is generated directly from business records without an expert witness.

⁵¹ 28 U.S.C. § 1732(a) (1970). The Federal Business Records Act is an adaptation of the Model Business Records Act. See 5 J. WIGMORE, EVIDENCE § 1520, at 365 (3d ed. 1940); *id.* § 1530, at 391.

⁵² This rule was developed in the seventeenth century as a narrow exception to the hearsay rule. It generally permitted the introduction of shop books only to prove amounts due; further, the books had to be properly authenticated, and the makers of the records had to be examined. See 5 J. WIGMORE, *supra* note 51, § 1519.

⁵³ The relevant portion of the Act provides:

In any court of the United States and in any court established by Act of Congress, any writing or record, whether in the form of an entry in a book or otherwise, made as a memorandum or record of any act, transaction, occurrence, or event, shall be admissible as evidence of such act, transaction, occurrence or event, if made in regular course of any business, and if it was the regular course of such business to make such memorandum or record at the time of such act, transaction, occurrence or event or within the reasonable time thereafter.

All other circumstances of the making of such writing or record, including lack of personal knowledge by the entrant or maker, may be shown to affect its weight, but such circumstances shall not affect its admissibility.

28 U.S.C. § 1732(a) (1970); see *Williams v. Humble Oil & Ref. Co.*, 53 F.R.D. 694 (E.D. La. 1971).

⁵⁴ § 1. *Definition*.—The term "business" shall include every kind of business, profession, occupation, calling or operation of institutions, whether carried on for profit or not.

§ 2. *Business Records*.—A record of an act, condition or event, shall, in so far as relevant, be competent evidence if the custodian or other qualified witness testifies to its identity and the mode of its preparation, and if it was made in the regular course of business, at or near the time of the act, condition or event, and if, in the opinion of the court, the sources with information, method and time of preparation were such as to justify its admission.

Uniform Business Records As Evidence Act §§ 1 & 2, 9A U.L.A. 506; see 5 J. WIGMORE, *supra* note 51, § 1520, at 361ff. The Uniform Business Records As Evidence Act might be considered more restrictive than the Federal Business Records Act, since the Uniform Act specifically requires testimony authenticating the records, specifying the mode of preparation, and confirming that they were made in the regular course of business and near the time of the event. These conditions are, however, arguably implicit in the Federal Business Records Act.

In considering the issues raised by computer-generated evidence and the courts' treatment of those issues, it is important to appreciate the flexibility inherent in the relevant rules of evidence. At least in the federal courts, there has been a tendency towards liberalization of the rules of evidence in recent years.⁵⁵ Rule 803(6) of the Proposed Federal Rules of Evidence, which deals with business records, reflects this trend.⁵⁶ Under a stricter set of evidentiary requirements, much computer-generated evidence might be inadmissible or the requirements for its admission might be so burdensome as to destroy its usefulness.⁵⁷ There is, however, a danger that computer-generated evidence will be admitted too easily. The computer can package data in a very enticing manner, and, since it might be difficult to look behind that package, there may be a tendency simply to admit the material "for what it is worth." Proper evaluation of computer-generated evidence requires both that a careful evaluation be made of the original source of the evidence and that the proponent make available at least one witness who can answer the questions posed in the analysis outlined above.

B. The Case Law

In *United States v. DeGeorgia*,⁵⁸ the defendant was charged with interstate transportation of an automobile stolen from the Hertz Corporation. The prosecution offered to prove that the car was stolen by showing that, according to Hertz's master computer, the automobile had not been rented from Hertz during the relevant period. A copy of the computer-generated data was not offered into evidence; all that was offered was the testimony of a Hertz employee on what that data reported.⁵⁹

⁵⁵ See cases cited notes 64 & 65 *infra*.

⁵⁶ Rule 803 provides:

The following are not excluded by the hearsay rule, even though the declarant is available as a witness:

.....

(6) *Records of regularly conducted activity.* A memorandum, report, record, or data compilation, in any form, of acts, events, conditions, opinions, or diagnoses, made at or near the time by, or from information transmitted by a person with knowledge, all in the course of a regularly conducted activity, as shown by the testimony of the custodian or other qualified witnesses, unless the source of information or other circumstances indicate lack of trustworthiness.

93 S. Ct. 111-12 (1972).

⁵⁷ As Judge Learned Hand said: "Unless [records] can be used in court without the task of calling those who at all stages had a part in the transaction recorded, nobody need ever pay a debt, if only his creditor does a large enough business." *Massachusetts Bonding & Ins. Co. v. Norwich Pharmaceutical Co.*, 18 F.2d 934, 937 (2d Cir. 1927).

⁵⁸ 420 F.2d 889 (9th Cir. 1969).

⁵⁹ A Hertz security officer testified that he received information indicating that the car might have been stolen and that he checked the master computer control through a terminal in his office. He ascertained that the automobile in question had been returned to Hertz almost a month earlier and that no subsequent rental activity was recorded, thus indicating that the vehicle had been stolen. *Id.* at 891.

The opinion is unclear about what evidence was offered to prove the validity of the data, but that evidence was apparently limited to a showing that Hertz relied on such data in conducting its business affairs.⁶⁰ The court, pointing to Rule 803(7) of the Proposed Federal Rules of Evidence,⁶¹ concluded that the evidence was admissible under the Federal Business Records Act⁶² to prove that the automobile had not been rented.⁶³

In *D & H Auto Parts v. Ford Marketing Corp.*,⁶⁴ Ford offered to show the amount of sales to D & H by introducing monthly sales summaries prepared on Ford's computers from information provided by Ford's parts distributors. The summaries were normally intended for internal use. In support of these documents, Ford offered the testimony of its assistant controller who described the testing of the data. D & H objected to the offer of the sales summaries on the grounds that there was insufficient proof of the accuracy of the printouts and that the testimony offered in support of the evidence was inadequate. The court, citing *DeGeorgia*, ruled that the computer printouts had been properly admitted: "Under the Business Records Act the absence of testimony from other Ford personnel 'may be shown to affect its weight, but such circumstances shall not affect its admissibility.'"⁶⁵

The state courts, acting under the shop book rule and its statutory

⁶⁰ *Id.* at 893 n.11. The opinion does not indicate that the security officer had any knowledge of the actual operation of the Hertz EDP system.

⁶¹ Rule 803(7) provides:

Absence of entry in records of regularly conducted activity. Evidence that a matter is not included in the memoranda, reports, records, or data compilations, in any form, of a regularly conducted activity, to prove the nonoccurrence or nonexistence of the matter, if the matter was of a kind of which a memorandum, report, record, or data compilation was regularly made and preserved, unless the sources of information or other circumstances indicate lack of trustworthiness.

⁶² 93 S. Ct. 112 (1972).

⁶³ 28 U.S.C. § 1732(a) (1970).

⁶⁴ 420 F.2d at 894. In a concurring opinion Judge Ely questioned the validity of the admission of this testimony. He correctly pointed out that the evidence offered was a summary of other records and stated that if an objection had been made based on the best evidence rule, he would have been more troubled by its admission. Finally, he cautioned that the Federal Business Records Act should not be construed as authorizing admission of any and all information that can be obtained from the records of businesses. *Id.* at 895.

⁶⁵ 57 F.R.D. 548 (E.D.N.Y. 1973).

⁶⁶ *Id.* at 551. The court's decision was clearly influenced by the fact that D & H, which had possession of the printouts for more than six months prior to the trial and had pre-marked them for use as its own exhibits, had not mentioned the alleged deficiencies to the court or Ford prior to trial. Nevertheless, another court has stated that "printouts . . . produced in the ordinary course of business . . . have a prima facie aura of reliability." *Olympic Ins. Co. v. H.D. Harrison, Inc.*, 418 F.2d 669, 670 (5th Cir. 1969). *But see* *Sunset Motor Lines, Inc. v. Lu-Tex Packing Co.*, 256 F.2d 495 (5th Cir. 1958), rejecting computer-generated forms that were assumed to be within the business records exception because the certification required by Federal Rule of Civil Procedure 44(a) was lacking.

codifications, have also exhibited a propensity to admit computer-generated material into evidence. A leading case considering the issue of computer-generated evidence is *Transport Indemnity Co. v. Seib*.⁶⁶ To establish the amount of a premium claimed in a civil action, the plaintiff offered a computer-prepared exhibit reporting the defendant's losses and calculating the premium due. The plaintiff offered the testimony of its director of accounting in support of the exhibit; he testified that the computer records were maintained under his control, that the information on losses was fed into and stored in the computer, and that the computer stored and calculated the information in the same manner as plaintiff's previous bookkeeping. The court found that the records and computations were made as a usual and necessary part of the plaintiff's business operation. The Uniform Business Records As Evidence Act⁶⁷ had been adopted in that state, and the court refused to construe the statute narrowly:

No particular mode or form of record is required. The statute was intended to bring the realities of business and professional practice into the courtroom and the statute should not be interpreted narrowly to destroy its obvious usefulness. [Citation omitted].

The machine here performs the bookkeeping task in the usual course of business. Instead of on paper, the information and calculations are stored on tape and may be retrieved and printed at any time. The taped record furnished a cumulative record based on information flowing into the office of the plaintiff company day by day and fed into the machine in response to a systematic procedure for processing each insured's account.⁶⁸

In *King v. State ex rel. Murdock Acceptance Corp.*,⁶⁹ the court, acting without benefit of a statutory business records rule, admitted into evidence computer sheets that purported to reflect the balance due on six conditional sales contracts. The plaintiff's accounting manager testified that the computer sheets were prepared under his supervision in the normal course of business. He traced the flow of data through the EDP system, described verification procedures, and testified that the computer equipment was standard equipment recognized as efficient and accurate. The court stated that the plaintiff's records of customers' accounts would meet the shop book rule if conventional books were used but recognized that the question was whether the printout sheets were inadmissible be-

⁶⁶ 178 Neb. 253, 132 N.W.2d 871 (1965).

⁶⁷ See note 54 *supra*.

⁶⁸ 178 Neb. at 259, 132 N.W.2d at 875.

⁶⁹ 222 So. 2d 393 (Miss. 1969).

cause they were not the original records. The court, citing *Seib*, decided to admit the printout sheets; the court maintained that it was not departing from the shop book rule but only extending its application to electronic bookkeeping.⁷⁰

The reported cases are not clear about the type of testimony necessary to provide an adequate foundation for the admission of computer-generated data. In *Seib* and *King*, the individual directly responsible for the operation of the EDP system testified and probably could have answered those questions set forth in the analysis outlined above. It could be argued, however, that the party offering the evidence need show only that the computer-generated data was used in the normal course of business or was generated from computer-maintained data used in the normal course of business. Those witnesses who testified in *D & H Auto Parts* and *DeGeorgia* could not have given more than this information; the Hertz employee in *DeGeorgia* apparently could testify only that he relied on the computer printouts in carrying out his duties for the company.

Some cases have raised a question regarding the applicability of the personal knowledge requirement of various evidence rules. A fairly liberal view was adopted in *Merrick v. United States Rubber Co.*⁷¹ The plaintiff, in support of computer-generated data, offered the testimony of an employee in its credit department who was familiar with the account in question and plaintiff's accounting procedures, but who had no personal knowledge about the operations of the plaintiff's computer system. The court rejected the defendant's contention that this testimony was not an adequate foundation to justify the admission of the computer-generated evidence.

Other courts have applied stricter tests than the *Merrick* court. In *Arnold D. Kamen & Co. v. Young*,⁷² the plaintiff sought to introduce a computer-generated statement of accounts, purchases, and sales. A witness testified that employees transferred information from written order

⁷⁰ In sum, we hold that printout sheets of business records stored on electronic computing equipment are admissible in evidence if relevant and material, without the necessity of identifying, locating, and producing as witnesses the individuals who made the entries in the regular course of business if it is shown (1) that the electronic computing equipment is recognized as standard equipment, (2) the entries are made in the regular course of business at or reasonably near the time of the happening of the event recorded, and (3) the foundation testimony satisfies the court that the sources of information, method and time of preparation were such as to indicate its trustworthiness and justify its admission.

We are not to be understood as indicating that computer evidence is infallible. Its probative value is the same as conventional books and it is subject to refutation to the same extent.

Id. at 398-99.

⁷¹ 7 Ariz. App. 433, 440 P.2d 314 (1968).

⁷² 466 S.W.2d 381 (Tex. Civ. App. 1971).

blanks to keypunch cards which were then sent to a tabulating service that ran the cards through a computer and returned the printouts. He further testified that the printout was part of the business records of the company kept for each customer. The defendant argued that the data was not admissible because the plaintiff had not shown that the original data was prepared by someone with personal knowledge of the act or event recorded. The court held that the evidence was inadmissible because "there was no proof that the person who prepared the order blanks or other data had personal knowledge of the data or information allegedly punched into the cards. [The witness] did not attempt to testify that he had knowledge of such information but merely said that the cards were punched by a female employee in the Chicago office based on certain orders not shown on the record."⁷³

Further confusion about the admissibility of computer-generated evidence is created by uncertainty about the applicability of the best evidence rule.⁷⁴ This rule, which requires introduction of the documentary originals, raises difficult questions where information is stored in a computer or on punch cards or tape readable only by a machine. In these situations, there is no record like the conventional documentary original, but the accepted policy justification of the best evidence rule is nevertheless applicable.⁷⁵ The courts generally have not insisted on strict application of the rule in cases involving records stored by more modern techniques; in one case, for example, the court treated computer printouts as "shop books."⁷⁶ In *Harned v. Credit Bureau*,⁷⁷ however, the court barred a computer-generated summary of accounts, because the summary violated the best evidence rule. Although this case may seem to be inconsistent with the majority view, the court stated that the summary would have been admissible if the original records had also been introduced and available for cross-examination.⁷⁸ Careful examination

⁷³ *Id.* at 387.

⁷⁴ In proving the material terms of a writing, the original writing must be produced unless it is unavailable for an acceptable reason.

⁷⁵ The rationale for the best evidence rule is the importance of precision in written documents; a slight change in wording might drastically alter the legal rights established by the writing in question. C. McCORMICK, EVIDENCE § 231, at 561 (2d ed. 1972).

⁷⁶ *King v. State ex rel. Murdock Acceptance Corp.*, 222 So. 2d 393 (Miss. 1969); *cf. Transport Indem. Co. v. Seib*, 178 Neb. 253, 132 N.W.2d 871 (1965). *See also United States v. DeGeorgia*, 420 F.2d 889 (9th Cir. 1969).

⁷⁷ 513 P.2d 650 (Wyo. 1973).

⁷⁸ *See Proposed Federal Rule of Evidence 1006*, 93 S. Ct. 154 (1972). *Harned* would apparently not prevent the use of computer-generated evidence but would require adequate disclosure of supporting documentation. This rule may create some hardships in cases in which input is made directly to computers through terminals or in situations in which "hard" data is generated or retained in the computer system. In any event, the facts of that case justify the result. The defendants claimed that they had paid all received bills and offered cancelled checks showing payment; the plaintiff offered a computer printout

of the way in which the computer records are translated into the print-out is of course necessary to serve the policies behind the best evidence rule.

CONCLUSION

The reported case law on issues raised by computer-generated evidence is obviously superficial. If there is a discernible trend, it is the tendency to admit computer-generated evidence, often without a satisfactory foundation, and then to let all questions about the credibility and validity of the evidence affect only the weight of the evidence. The effect of this type of ruling is to shift the burden of proof. Despite the obvious justification for a liberal construction of the rules of evidence, favoring the admission of all relevant evidence, the wholesale admission of computer-generated evidence without requiring adequate foundation is unwise.

Computer-generated evidence is one of the most dangerous types of evidence because of the computer's ability to package hearsay and erroneous or misleading data in an extremely persuasive format. The means used to create the evidence thus must be carefully examined to determine its admissibility, validity, and probative value. Since the creation of computer-generated evidence is an inherently complex process, the triers of fact are probably unable to undertake full and informed evaluation of such evidence, and they may be subject to a subconscious bias that data generated by a computer is inherently correct.

The blame for inadequate examination of the value of the evidence must be placed squarely on the shoulders of those practitioners who have the responsibility of opposing the introduction of computer-generated evidence. If those practitioners are diligent in their efforts, proponents of such evidence will have to prepare their evidence carefully; the courts will be fully informed and able to make more meaningful decisions regarding computer-generated evidence.

The practitioners on both sides of a case may find that they must work a little more strenuously in preparing computer-generated evidence than other types of evidence. To deal with computer-generated evidence, both the proponent and opponent should perform an analysis similar to that suggested in this article. Full discovery and extensive pretrial conferences are necessary to clarify and perhaps to resolve objections that might exist.

statement that conflicted with the defendants' evidence. The evidence raised serious questions about whether the defendants had ever been billed for the uncollected amount. In these circumstances, the court was concerned about the "frightening prospect . . . that a person could be sued for services rendered and have the plaintiff base its claim solely on a recapitulation of computer printout sheets." *Id.* at 652.

If the members of the legal profession become sufficiently conversant with computer technology and its applications in generating evidence, the traditional rules of evidence may be adequate to handle the questions raised by computer-generated evidence. The paucity of reported cases dealing with computer-generated evidence, however, indicates that the members of the legal profession do not yet appreciate the usefulness of the computer as a device for generating and analyzing evidence.

The current impact of the computer on the law and the practice of the law is only the tip of the iceberg, and that impact will increase at a geometric rate. The members of the legal profession must equip themselves to deal with the impact of the computer, on the law and on our society and must learn to use the computer as a tool in the practice of law. The attorneys who fail to do so may become obsolete in the very near future.