Am Jur Trials

COMPUTER TECHNOLOGY

in

CIVIL LITIGATION

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VII. ADMISSIBILITY OF COMPUTER EVIDENCE

A. Computer Evidence

§ 128. In General

The broad, generic term "computer evidence" should be divided into two specific classifications: (1) computerized business records and (2) computer-generated evidence.

The distinction between the two types of evidence is based on the use of the computer to simply arrange or compile objective input data, as opposed to the use of the computer to analyze objective input data and generate conclusions based on assumptions contained within the program being run. The term "computerized business record" is used to refer to material (usually a printout) compiled by the computer in a preordained fashion from input data or from calculations performed by the computer based on input data. Where the computer develops evidentiary material based on input data and assumptions contained within the program itself, the result is computer-generated evidence, which, as used in this article, typically refers to courtroom exhibits such as computer graphics and simulations.

It is important to understand that the fundamental rules for the admission in evidence of computerized business records and computer-generated courtroom exhibits are not changed by virtue of the fact that the evidence was stored in or generated by a computer. The foundation for a computerized business record is basically the same as it is for a paper business record (see §§ 132-137), and whether purely demonstrative or experimental, computer-generated evidence requires the same showing of accuracy of depiction or similarity of conditions as a prerequisite for admission (see §§ 138-144).

References

Eastin, The Use of Models in Litigation: Concise or Contrived? 52 Chi-Kent L Rev 610 (1976).

Proof of Facts: For an extended discussion of the rules for the admissibility of computer printouts and other computer materials as evidence, including illustrative proofs for the introduction and admission of such evidence, see Admissibility of Computerized Business Records, 14 POF2d 173; Computer Printouts as Evidence, 16 POF 273.

ALR Annotation: For a collection of cases on the issue of computerized business records as evidence, see *Admissibility of computerized private business records,* 7 ALR4th 8.

§ 129. Basic Definitions

Computerized business records are, as the name suggests, the client's business information and data that have been stored in electronic databases. Computer-generated demonstrative evidence is a wider field, covering static illustrations of scenes, objects or events involved in litigation, and animated graphic presentations used principally to illustrate the testimony of expert witnesses or demonstrate the output of experimental studies.

The term "computerized business records" should not be interpreted in a restrictive sense and limited to computer data that resides passively in an electronic database. Business records are part of a commercial process, and information put into a computer is used as well as stored. The fact that data is manipulated in some way during business operations does not disqualify it as a business record. Typically, business information is compiled, calculated, recalculated, merged, sorted, and revised during the regular course of a firm's operations. Hence, computerized business records also include business information used in spreadsheets, data sorts, mathematical computations, and list compilations.

Computer-generated evidence, of which simulations and models are the most common type, is also referred to as "computer-created" evidence. The computer generates the evidence in the same sense as a camera creates photographic evidence, however. The scene exists in the real world and the camera produces an accurate version of it but in a different form. With computer-generated evidence, much the same process is followed. The computer must have precise data from the field on which to run a reliable program and the output must be verifiable as accurate. The basic difference is that the computer output can be dynamic and animated as well as static and purely illustrative.

Notes

In the field of computer technology as it applies to experimental and demonstrative evidence, objective verification can be a complex task. Questions as to what to verify and how to verify it are mere threshold inquiries. What happens to the verification if the program is changed? Can the operator test all possible permutations of statements in a program? Defining "accurate" is a problem in some cases.

§ 130. Mechanical Failures

The courts seem to feel that they have been drawn willy-nilly into the magic world of computerization that is seen as esoteric and mysterious. (*Commonwealth v Klinghoffer* (1989, Pa) 564 A2d 1240, dissenting opinion, Rolf Larsen, J.) There is also a nagging fear that, as a machine, the computer cannot be entirely trusted. The truth is otherwise, however.

Computers are basically *dumb* machines; they can do only what they are told to do. They are also robotic; they are programmed to respond in predictable ways and they rarely do otherwise. Computers are also like airplanes. They occasionally crash, but when they do the cause is more likely to have been human error then mechanical failure. Computers can produce abberational results on occasion, but when they do the cause is often in the external power supply rather than in the electromechanical connections in their electronic boxes.

The probability of the mechanical component of the computer system committing an undetected error is minimal. Internal tests constantly monitor the equipment to ensure that there are no electrical or mechanical malfunctions, and external programs are run to detect equipment failures. 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 or "scrambles" stored data. Most computers are equipped with devices that shut down the computer when the power supply varies from acceptable levels, however. (Roberts, A Practitioner's Primer on Computer-Generated Evidence, 41 U Chi L Rev 254, 263 n 32 (1974).) Most computers also have sophisticated back-up systems that can recover computer documents that are lost or damaged due to electromechanical failures or human errors.

§ 131. Software Considerations

Establishing the *competence* of computer evidence normally presents the greatest hurdle that must be overcome before it will be admitted. Evidence generated through the use of standard, generally available software is easier to admit than evidence generated with custom software. The reason lies in the fact that the capabilities of commercially marketed software packages are well known and cannot normally be manipulated to produce aberrant results. Custom software, on the other hand, must be carefully analyzed by an expert programmer to ensure that the evidence being generated by the computer is in reality what it appears to be. Nonstandard or custom software can be made to do a host of things that would be undetectable to anyone except the most highly trained programmer who can break down the program using source codes and verify that the program operates as represented.

Notes

The term "standard software" refers to those programs publicly available in the marketplace, while "custom" or "proprietary software" is software developed by or especially for the user.

B. Computerized Business Records

§ 132. Identification and Authentication

The identification and authentication of computerized business record evidence is fairly straightforward. Electronic computer storage is generally considered a "data compilation" for evidence purposes (Federal Rule of Evidence 803(6)) and a computer printout is generally regarded as an *original* "writing" (Federal Rule of Evidence 1001(1)(3).) Evidence describing the process used by a computer to store and produce data and showing that the process produces accurate results is usually sufficient to support a finding as to the authenticity of the evidence. (Federal Rule of Evidence 901(b)(9).) In some jurisdictions even that showing is waived and a computer printout may be *presumed* to be an accurate representation of the data (information or programs) that it purports to represent. (See California Evidence Code § 1500.5.)

Notes

Records reproduced by digitized document imaging or stored and retrieved on laser-readable disks will be subject to challenges that are similar to those initially voiced against computer printouts. This technology produces an *exact image* of the stored document, however, and, if anything, the output is more authentic and reliable. See §§ 161-163.

§ 133. Rule of Admissibility

Computerized business records are no less hearsay than paper records of the same acts, conditions, or events that they purport to prove. Hence, they must qualify for admission as an exception to the rule against hearsay evidence. Thus, a computerized business entry that constitutes a record of an act, condition, or event is admissible to prove the act, condition, or event provided (1) the record was made in the regular course of business at or near the time of the act, condition, or event recorded; (2) a qualified witness testifies to its identity and mode of preparation; and (3) the sources of information and method and time of preparation were such as to indicate its trustworthiness. (See, for example, Federal Rule of Evidence 803(6); California Evidence Code §§ 1270-1272.)

Computer evidence that satisfies the foundation for an exception to the rule against hearsay should be admitted; it is immaterial that the business records were maintained in computer databases rather than in company books so long as the proponent lays the proper foundation. (*United States v Catabran* (1988, CA9 Cal) 836 F2d 453, 1988 US App LEXIS 66, 24 Fed Rules Evid Serv 459 [computer records compiled by bankrupt's bookkeeper at bankrupt's direction admissible].) The

majority of courts do not require the proponent of computerized business records to introduce testimony on the acceptability and reliability of the particular hardware and software, or on internal maintenance and accuracy checks, as a prerequisite to admissibility. (*People v Lugashi* (1988, 2nd Dist) 205 Cal App 3d 632, 252 Cal Rptr 434, review den.)

In some states, however, more is required of the proponent of computer-stored evidence than is required of the offeror of business records compiled by hand in the traditional fashion. In Illinois, for example, it must also be shown that the electronic computing equipment from which the evidence was derived was "standard." (*People v Mormon* (1981, 1st Dist) 97 Ill App 3d 556, 52 Ill Dec 856, 422 NE2d 1065, affd *People v Mormon* (1982) 92 Ill 2d 268, 65 Ill Dec 939, 442 NE2d 250; *People v Boyd* (1978, 1st Dist) 66 Ill App 3d 582, 23 Ill Dec 620, 384 NE2d 414.) Where no attempt is made to show that computer printouts offered in evidence are the product of a standardized computer system, the foundation may be faulty and the trial court might not admit the printouts into evidence. (*Weisman v Hopf-Himsel, Inc.* (1989, Ind App) 535 NE2d 1222.)

Notes

A computer record is not admissible if the source of information or the method or circumstances of preparation indicate a lack of trustworthiness. *Kennedy v Los Angeles Police* (CA 9, Cal) 1989 US App LEXIS 15373 (computer time records kept by counsel in a civil rights case admissible).

The foundation for computer records of telephone calls made by a party does not require a showing that the particular computer equipment is recognized as standard; nor does it require proof that the records were prepared by persons who had a regular duty to operate the equipment and who understood its operations. *Hinkle v State* (1989, Tex App Beaumont) 779 SW2d 504.

Federal court decisions are numerous admitting computer printouts as business records so long as they comply with the requirements of Rule 803(6). Records of automatic teller machine transactions are one example. See *United States v Bonallo* (1988, CA9 Or) 858 F2d 1427, 26 Fed Rules Evid Serv 1085; *Central Fidelity v Denslow* (Virg 1989) 1989 US Dist LEXIS 11106. Computer-generated telephone toll logs are similarly admissible. See *United States v Linn* (1989, CA9 Wash) 880 F2d 209; *United States v Miller* (1985, CA9 Idaho) 771 F2d 1219, 19 Fed Rules Evid Serv 647. See also *United States v Hayes* (1988, CA10 Colo) 861 F2d 1225, 27 Fed Rules Evid Serv 55, 63 AFTR 2d 89-306 (IRS computer records admissible); *United States v Puente* (1987, CA5 Tex) 826 F2d 1415, 24 Fed Rules Evid Serv 60 (computer records recording entry times of vehicles into the United States admissible); *United States v Croft* (1984, CA7 Wis) 750 F2d 1354, 16 Fed Rules Evid Serv 1141 (payroll computer records admissible); *United States v Sanders* (1984, CA5 Tex) 749 F2d 195, 16 Fed Rules Evid Serv 1274 (computer print out generated by key punch operator as transcribed from another source admissible); *Phoenix v Com/Systems, Inc.* (1983, CA9 Ariz) 706 F2d 1033, 13 Fed Rules Evid Serv 557 (computer summary of data compilation admissible).

Am Jur: On the admissibility of computer evidence of business and public records under the Federal Rules of Evidence see, 32B *Am Jur* 2d, Federal Rules of Evidence §§ 235-244, 286-288, 294, 311 (1982). See also *Federal Manual of Complex Litigation* § 2.714.

§ 134. Computerized Public Records

Any official record of a governmental agency, or a properly authenticated copy or transcript of an official or public record, is admissible in the trial of an action, subject to the same requirements of relevancy and materiality as apply to private writings. Authentication is made by producing the original record or a properly certified copy. (Federal Rule of Civil Procedure 44.)

Properly authenticated public records also qualify as an exception to the rule against hearsay. Thus, records, reports, statements, or *data compilations,* in any form, of public offices or agencies, setting forth the activities of the office or agency, or matters observed pursuant to duty imposed by law as to which matters there was a duty to report, are admissible unless the sources of information or other circumstances indicate lack of trustworthiness. (Federal Rule of Evidence 803(8).) When admitted the exhibits constitute evidence of those matters which are properly required to be maintained and recorded in the records. (Many jurisdictions have enacted statutes providing for the admissibility of public records. See, for example, California Evidence Code §§ 1280-1284. See generally 30 *Am Jur* 2d, Evidence § 1012 (1967).

Public records are seen as inherently trustworthy based on the assumptions that public officers will perform their duties and are without motive to falsify. The foundation rule is not changed by the fact that the storage medium was a computer. Printouts of computerized public records are generally admissible to the same extent that printouts of computerized business records are admitted. Thus, computer records of food stamp disbursements maintained by a state social services department fall within the public records exception to the hearsay rule and are admissible to the same extent as paper records of the same facts. (*Eastman v Department of Public Aid* (1989, 2d Dist) 178 Ill App 3d 993, 128 Ill Dec 276, 534 NE2d 458 [same foundation required of computer evidence whether offered in court or at administrative hearing). The federal rule is basically the same]. See *United States v Enterline* 1990 US App LEXIS 575 [computer record of stolen cars admissible under FRE 803]).

References

Am Jur: On the admissibility of public or official records and reports, see 30 *Am Jur* 2d, Evidence § 962-1015 (1967).

Am Jur: For a general discussion of Rule 44, see 30 *Am Jur* 2d, Evidence §§ 997, 1012 (1967). On the authentication and identification of public records and reports under the Federal Rules of Evidence, see 32B *Am Jur* 2d, Federal Rules of Evidence § 286 (1982).

§ 135. Foundational Witnesses

For the admission of computerized business records, the foundational witness need not be a computer specialist. A person who generally understands the system's operation and possesses sufficient knowledge and skill to properly use the system and explain the resultant data is a "qualified witness" for purposes of establishing the necessary foundation for the introduction of computer printouts as business or public records. The witness need not be able to perform every task concerning the evidence from initial design and programming to the final printout. (*People v Lugashi* (1988, 2nd Dist) 205 Cal App 3d 632, 252 Cal Rptr 434, review den.)

This type of foundational witness is typically the client's computer record keeper who understands the operation of the machine, who can identify the computer records, and who can verify that they were retrieved from the computer system. Computer hardware systems and the software applications that run them are increasing in complexity, however, and in a particular case special expertise may well be called for. This is particularly true where the data, rather than having been merely passively stored in the computer, was subject to some computer-assisted analysis such as data sorting, mathematical calculations, statistical models, time sequences, or statistical trends. In this regard counsel may want to call a technician or a computer analyst as the foundational witness.

A *computer technician* is often a firm's electronic data-processing (EDP) specialist who services and manages the particular computer system in question. This witness can explain how the computer works and how a mass of material fed into the computer has been manipulated into the evidence offered. When the foundation requires a showing that the hardware is standard and reliable, this witness should be able to verify that the computer equipment is sufficiently reliable for the output to be worthy of admission. The technician should also be articulate enough to explain to a trial judge and lay jury how the computer performs the operations in question.

When the admissibility or credibility of computer business evidence depends on the application of the data within the computer system, the *computer analyst* should be called as a foundational witness. The analyst is a particularly helpful witness when computer data requires interpretation and analysis to be fully understood by the jury in the courtroom. Familiarity with the operation of the computer is essential, as is a knowledge of the software used to perform an analysis. An EDP auditor, a systems engineer, or even a salesperson particularly well versed in the capabilities of the software are likely candidates.

References

Pilkington, Handling Testimony on Computerized Records, 15 Litigation 31 (Summer 1989).

§ 136. Laying the Foundation

While most courts apply a liberal rule to the foundation required for the admission of computerized business records, the following steps should always be considered if not applied in developing the foundation for the admission of such evidence in court. Hence, the proponent of a printout of computerized business records should produce proof sufficient to sustain a finding on each of the following facts:

1. The reliability of the computer equipment to keep the records and produce the printout, which may also require a showing of the competency of the computer operator, both with respect to maintenance and data input.

2. The manner in which the basic data was initially entered into the computerized recordkeeping system, which may require testimony concerning the computer's operating system.

3. The data was entered into the system in the regular course of the proponent's business.

4. The data was entered within a reasonable time after the events recorded by persons having knowledge of the events recorded or from information transmitted by persons with knowledge of the events.

5. The measures taken by the proponent to ensure the accuracy of the data.

6. The method of storing data and the precautions taken to prevent loss or damage while in storage.

7. The reliability of the computer programs used to process the data.

8. The measures taken to verify the accuracy of the program.

9. The time and mode of retrieving the data and preparing the printout.

§ 137. Opposing Admission

The party against whom computer-generated business records is offered as evidence must be given the same opportunity to inquire into the accuracy of such records as is provided for inquiring into the accuracy of other written business records. An objection for lack of sufficient foundation should be made where there is any omission in the elements of the foundation and where there are weaknesses in the proof of the preliminary facts which suggest lack of trustworthiness of the computerized record or a printout. The failure to make an appropriate objection to the foundation for a computerized business (or public) record generally results in a waiver and cannot be asserted for the first time on appeal. (See *United States v Fendley* (1975, CA5 Tex) 522 F2d 181.)

References

Proof of Facts: For an illustration of the direct examination and the cross-examination of an authenticating witness respecting the admission of computerized business records, see Admissibility of Computerized Business Records, 14 POF2d 173, §§ 27-37.

C. Computer-Generated Evidence

§ 138. In General

Computer-generated evidence generally falls into two separate categories: it may be purely demonstrative or it may be essentially experimental. It is usually presented in two different ways: computer-generated evidence that is principally demonstrative tends to be presented in a static mode; computer-generated experimental evidence tends to be shown in a dynamic or animated state.

A simple overhead drawing of an intersection where an accident occurred created in a computer through a computer-aided design (CAD) program is an example of computer-generated demonstrative evidence. (See § 98.) A computer simulation of a car overturning while making a turn due to a failed steering component is an example of computer-generated experimental evidence. (See § 83.) When the output of the mathematical model used to produce the simulation is converted to

animated display graphics, the evidence also takes on a demonstrative character. A simulation may be run with a CAD program to produce an animated video showing the movement of two cars involved in an accident before and after impact. This evidence is both demonstrative and experimental. (See *Starr v Campos* (1982, App) 134 Ariz 254, 655 P2d 794 [computer simulation of an automobile accident]; *Schaeffer v General Motors Corp.* (1977) 372 Mass 171, 360 NE2d 1062, 100 ALR3d 462 [program used by defense in auto product liability suit to create a computer simulation of an automobile crash].)

Simulations are also used on issues other than negligence and causation. For example, a simulation of the takeoff and flight of a commercial airplane was used in one case to show its descent and crash to support a claim of pre-impact fear and mental suffering of the decedent on the issue of damages. (See *Haley v Pan American World Airways, Inc.* (1984, CA5 La) 746 F2d 311, 316, 16 Fed Rules Evid Serv 941.) Simulations are used extensively to support expert testimony in commercial litigation. (See, for example, *Perma Research & Dev. Co. v Singer Co.* (1975, SD NY) 402 F Supp 881, affd *Perma Research & Dev. Co. v Singer Co.* (1976, CA2 NY) 542 F2d 111 [simulation used to prove the feasibility and marketability of an automotive anti-skid device]; *Pearl Brewing Co. v Jos. Schlitz Brewing Co.* (1976, SD Tex) 415 F Supp 1122, 21 FR Serv 2d 979 [simulation used to prove price fixing in antitrust case].) They also have been used in criminal cases. (See, for example, *People v M.* (1984) 124 Misc 2d 888, 476 NYS2d 723 [computer simulation of defendant's version of an accident admitted in criminal case].)

References

See, generally, Gordon, *System Simulation* 18 (1969); Favret, *Introduction to Digital Computer Applications* 122 (1965); Note, Computer Simulation and Gaming: An Interdisciplinary Survey with a View toward Legal Applications, 24 Stanford L Rev 712 (1972).

§ 139. Rule of Admissibility

Static depictions of objects, locations or events involved in litigation presented for purely demonstrative purposes are generally subject to the same rules of admissibility without regard to whether they were produced by a computer or drawn by hand. For this purpose, the computer is little more than a camera, and the foundation for admission of the illustration is largely the same: Does the representation accurately depict what it purports to portray?

The issue of "computer-generated" evidence, such as computer simulations or models derived from the computer's *programmed* analysis of objective data, raises different issues

as to its admissibility. Because such evidence is generally prepared in the context of expert testimony and because it constitutes or is adjunct to a "scientific technique," the standards for admissibility of scientific evidence are generally applied.

Scientific evidence may be admitted if it is derived from principles and procedures that have achieved general acceptance in the scientific field to which they belong. (See, generally, *Frye v United States* (1923) 54 App DC 46, 293 F 1013, 34 ALR 145.) What this means in an individual case varies, but at a minimum the reliability of the evidence and the means used to produce it must be adequately established as prerequisites to its admissibility. It should also be shown that the conditions simulated were substantially similar to those that existed in the field, and when someone proposes that a simulation accords with reality, some testing must have been conducted to confirm that such is the case. (*Ohio v United States Environmental Protection Agency* (1986, CA6) 798 F2d 880, 16 ELR 20870 [Environmental Protection Agency's use of a computerized atmospheric model was arbitrary and capricious in the absence of any site-validation studies].)

§ 140. Reliability

A recent Michigan case provides an apt illustration of the usefulness of computer-generated evidence in a relatively simple negligence case. Plaintiff was injured in a car-train railroad crossing accident. In her action against the railroad she charged it with negligent operation of the train and negligent maintenance of the crossing. At the trial she produced an engineer whose expertise was in computer-generated accident reconstruction. Based on simulations he had run and demonstrated, he testified that, if the train's engineer had seen plaintiff's car when first possible, the engineer could have stopped the train in time to avoid the accident. He also concluded that a person approaching the crossing from the direction that plaintiff had approached would not have been able to avoid the accident. The jury gave plaintiff a verdict and the resulting judgment was affirmed on appeal. (*Petrove v Grand T. W. R. Co.* (1989) 174 Mich App 705, 436 NW2d 733.)

Computer-generated demonstrative and experimental evidence presents hazards that the admission of computer-stored business data does not. Computer-generated presentations are visual and highly dramatic, and they can make a great impression on lay minds. As a result, objections to the admission of the evidence are based on claims of undue prejudice as often as they are on claims of foundation weaknesses. (Seltzer, The Keys to Admissibility, 10 California Lawyer 78 (Feb 1990).) This evidence also comes in such a deceptively neat package that it can easily be the vehicle for introducing evidence that can be as erroneous, misleading, or unreliable as it can be accurate. (Roberts, A Practitioner's Primer on Computer-Generated Evidence, 41 U Chicago L Rev 254, 256 (1974).)

Computer-generated expert opinion, such as a conclusion about the speed of a specific vehicle under certain conditions, is reliable only insofar as the information fed into the program, the program itself, and the operation of the program have been accurate and complete. (*Commonwealth v Klinghoffer* (1989, Pa) 564 A2d 1240 (dissenting opinion, Rolf Larsen, J.) The computer can be erroneously programmed to display output in an inaccurate or biased manner and the error may go undetected. (Roberts, A Practitioner's Primer on Computer-Generated Evidence, 41 U Chicago L Rev 254, 256 (1974).) Therefore, a proper foundation for the admission of computer-generated experimental evidence (simulations) should be laid both as to the reliability of the simulation and its applicability to the event at issue. (M. Gemignani, *Computer Law* § 35:20A (1988 Supp).) In fact, some authorities would require a showing of a "high degree" of reliability as to the program and the input as a prerequisite to the admission of computer-generated evidence at trial. (See *Commonwealth v Klinghoffer* (1989, Pa) 564 A2d 1240 (dissenting opinion, Rolf Larsen, J.)

Notes

When a program flaw is revealed during trial, the results can be disastrous. For example, the credibility of a defense economist in an aircraft crash case was completely undermined when the plaintiff's expert, brought in on rebuttal, revealed that the computer-generated statistics used by the economic expert were seriously flawed. See *Douglass v Delta Air Lines, Inc.* (1989, WD Tex) 709 F Supp 745. See also *Shu-Tao Lin v McDonnell Douglas Corp.* (1983, SD NY) 574 F Supp 1407, 14 Fed Rules Evid Serv 887, affd in part and revd in part *Shu-Tao Lin v McDonnell Douglas Corp.* (1984, CA2 NY) 742 F2d 45, 16 Fed Rules Evid Serv 487, 39 FR Serv 2d 958 (an economist retained by plaintiff testified to decedent's likely future income based on computer projections; trial court set aside verdict in part because of flaws in expert's underlying assumptions).

§ 141. Anticipating Objections

One of the utilities of computer simulations is that it permits a great amount of "theory testing." Different hypotheses can be tested, and the input can be altered to check the results under different factual conditions. All of this can be done easily and quickly.

When preparing to offer evidence of computer-generated analytical studies or accident reconstructions, the proponent should anticipate objections to the use of evidence and prepare arguments in support of admissibility in advance of trial. Ideally, limited-issue trial briefs should be ready for filing with the trial court on each objection expected from the opponent of the evidence. The expert who will provide a foundation for admitting the evidence should be fully prepared to verify that the graphic presentation accurately depicts what it purports to illustrate and that it truthfully reflects his or her testimony.

Counsel should also consider preparing back-up exhibits for any presentation for which admissibility questions are a concern, and the graphics specialist should be on call to modify exhibits in the event the in-court foundation fails to satisfy the trial court's specifications. (Seltzer, The Keys to Admissibility, 10 California Lawyer 78 (Feb 1990).) The proponent should also have provided opposing counsel with a copy of the computer program embodying the simulation and the assumptions on which the simulation was based. (M. Gemignani, *Computer Law* § 35:20A (1988 Supp).)

§ 142. Foundational Witness

The law of the admissibility of computer simulations as evidence has not yet been fully developed. Nevertheless, in determining the admissibility of evidence of a computer simulation, the question whether the witness is qualified as an expert on its use is still left to the discretion of the trial court, the exercise of which will not be disturbed unless an abuse of discretion is demonstrated. For example, an engineer, who appeared as an expert for plaintiff in a railroad-crossing accident case, testified that he had a bachelor's degree in civil engineering, a doctorate in applied mechanics, and that he operated a company that was involved in computer-generated accident reconstruction. He had also published articles on computer simulations and lectured on the use of computers in accident reconstruction. Based on simulations of the accident which he had run, he was held to be properly qualified to testify that the engineer could have stopped the train in time to avoid the accident if he had seen plaintiff's car when first possible, and that a person approaching the crossing from the direction that plaintiff had approached would not have been able to avoid the accident. (*Petrove v Grand T. W. R. Co.* (1989) 174 Mich App 705, 436 NW2d 733.)

Although the foundational witness should be qualified as to the use of computers, he or she need not be a programmer. The witness need not understand each and every line of computer language in the program, particularly where the program is in the public domain or is generally available in the expert's field. The witness may be a user of the program along with hundreds of others, but the witness should also be one who understands the procedures extremely well and understands the physical laws that underlie the various functions of the program. (*Computers in Traffic Accident Reconstruction* at 19.)

§ 143. Scientific Foundation

The expert must believe in his or her opinion to a reasonable degree of scientific certainty *and* the scientific principles or theories on which the opinion is grounded must be generally accepted by the scientific community involved. That is, based upon knowledge, skill, training and experience, the expert witness must be able to testify that his or her opinion is correct based upon a reasonable degree of scientific certainty, and, if challenged,

must be prepared to demonstrate the general acceptance within the scientific community of the principle or theory upon which the opinion is based. The standard derives from *Frye v United States* (1923) 54 App DC 46, 293 F 1013, 34 ALR 145.

For example, the technique of computer modeling of the migration of contaminants in soil is a reasonably well-accepted technology today. The accuracy and reliability of results generated by computer modeling, however, vary greatly depending on the particular site being investigated. In the case of a well-defined site involving a single contaminant and a single type of soil, highly accurate geological and hydrological data, and detailed precipitation statistics, an expert could undoubtedly testify with a reasonable degree of scientific certainty that the opinion given (i.e., the results of the modeling) was accurate. When multiple variables are introduced, however, the point will soon be reached where the expert will be unable to testify that the opinion is accurate to a reasonable degree of scientific certainty, even though the basic principles of computer modeling are generally accepted by the scientific community involved. At that point the admissibility of the testimony may be questionable.

Similarly, if a challenge is made to the method of software development and operation (i.e., that the software has been inadequately developed, or has been developed to produce aberrational results), further expert testimony would presumably be required on the software development issue.

Problems regarding the scientific verification of a particular program can often be avoided at trial if there has been adequate disclosure to opposing counsel during pretrial discovery. In some cases, such disclosure may be a prerequisite to admissibility. In complex litigation in federal court, for example, computer inputs and outputs, the underlying data, and the program method employed with respect to computer-generated evidence must be made available to opposing counsel in advance of trial as a condition of admissibility. (*Federal Manual of Complex Litigation* § 2.714.)

Notes

The *Frye* standard may be liberalized in the case of computer simulations of auto accidents. See *Starr v Campos* (1982, App) 134 Ariz 254, 655 P2d 794 (computer simulation of an automobile accident; in view of widespread use and acceptance of computer technology the trial court may take judicial notice of the ability of a properly programmed computer to perform mathematical computation).

The need for pretrial disclosure is well illustrated in *Shu-Tao Lin v McDonnell Douglas Corp.* (1983, SD NY) 574 F Supp 1407, 14 Fed Rules Evid Serv 887, an economist retained by plaintiff testified to decedent's likely future income based on computer projections. The trial court set aside a $7,000,000 verdict in favor of the plaintiff in part because the plaintiff's failure to adequately disclose the experts' computer methodology and data during pretrial discovery deprived the defendant of an

adequate basis on which to cross-examine plaintiff's expert. This ruling was affirmed on appeal. See *Shu-Tao Lin v McDonnell Douglas Corp.* (1984, CA2 NY) 742 F2d 45, 16 Fed Rules Evid Serv 487, 39 FR Serv 2d 958.

§ 144. Laying a Foundation

Laying a foundation for the admission of computer simulations and their associated graphic presentations does not lend itself to a pat routine such as that for laying the foundation for admitting computerized business or public records. The elements are going to vary according to issues in the case and the technology employed in their proof or disproof. Nevertheless, the following five-step approach, taken from a forensic rather than legal source, can serve as an excellent guideline. (*Computers in Traffic Accident Reconstruction* at 18-20.)

1. *Qualify the expert:* Most expert witnesses who testify to computer simulations of highway accidents are not computer scientists. They must first qualify within their respective fields, and where computer-generated evidence is a part of their testimony, they must also demonstrate a sufficient understanding of the use of computers. The expert should be thoroughly acquainted with the basic assumptions and limitations that are incorporated in computer programs. These assumptions and limitations are normally listed in the documentation, and they should be properly applied in running the program. In running the program the expert will likely have made additional assumptions, and the expert must be prepared to defend these assumptions as well.

2. *Qualify the hardware:* While few courts require a foundation showing that the hardware used for a simulation was standard equipment, it is generally advisable to do so from a credibility standpoint. If the results were obtained using an untested prototype computer, it may be necessary to show that the computer produces valid results.

3. *Qualify the software:* Again, while not a required element of the foundation in all cases, it is advisable to qualify the software by showing that the computer program was valid, which can usually be done by the expert through the use of a study that compared the computer results with actual test data. Experience has shown that courts are much more willing to admit scientific evidence produced by an independent engineering analysis tool than scientific evidence produced by a tool specifically developed for litigation. Thus, whenever possible, a simulation should be run according to a proven program or model in the public domain or one that is generally available. Programs that are proprietary to the expert cause problems related to disclosure during pretrial and to reliability during trial.

4. *Qualify the input and output.* Each input variable is subject to scrutiny, so the expert must be able to explain the source of the data and justify reliance on it. The final step is

to explain how the results were obtained and what they mean. This step is required for any technical presentation of findings, and provides the basis for the expert's opinions.

5. *Absolute reliance on a computer simulation should be avoided.* A computer simulated accident reconstruction may not benefit the proponent in all cases. (See, for example, *Thibodaux Boiler Works v Southern Pacific Transp. Co.* (1974, La App 4th Cir) 302 So 2d 49 [simulation failed to support plaintiff's claim that defendant had last clear chance to avoid accident].) The simulation should be presented as only one of several tools the expert has to arrive at a scientific conclusion. Other methods of analysis include the witness' experience, supporting calculations, and field tests and experiments. Whenever possible the simulation output should be checked with reports of independent eyewitnesses. (*Computers in Accident Reconstruction* at 18.)

6. *The results of the simulation should not be oversold.* A computer simulation program is basically a preprogrammed series of calculations that represent the solutions to physics problems, which are only as correct as the input data used to produce them. Thus, the results should not be touted as accurate merely because they were produced by a computer. Nor should their accuracy be exaggerated. An accident reconstruction program may express the speed of a crash car as a precise figure, such as "46.75 mph." To express speed with such precision may not be viewed as credible by a lay jury, so the expert should express it as a range of figures. (See *State v Ortiz* (1982, RI) 448 A2d 1241, 37 ALR4th 501 [attempt to use a computer analysis of the defendant's mental condition at the time of the offense rejected].)

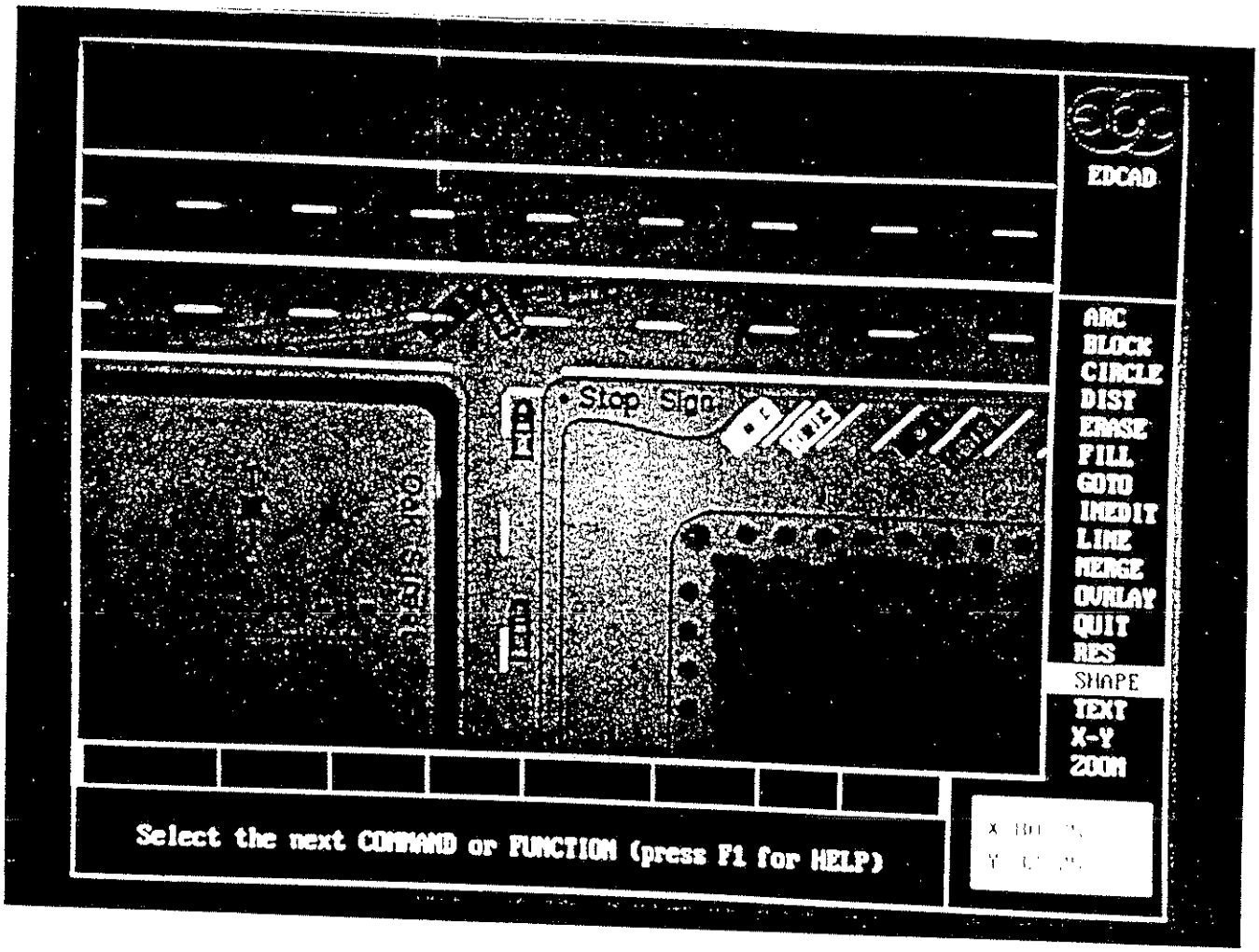

Figure 4.

This is a photograph of the display on a monitor showing an accident-site drawing of a two-car intersection collision. The human stick figure represents the location of one of the car occupants who was ejected from a vehicle in the collision. The computer-generated drawing was produced by EDCAD (Engineering Dynamics Computer-Aided Design), a program created by Engineering Dynamics Corporation. Photograph courtesy of Engineering Dynamics Corp., Lake Oswego, Oregon.

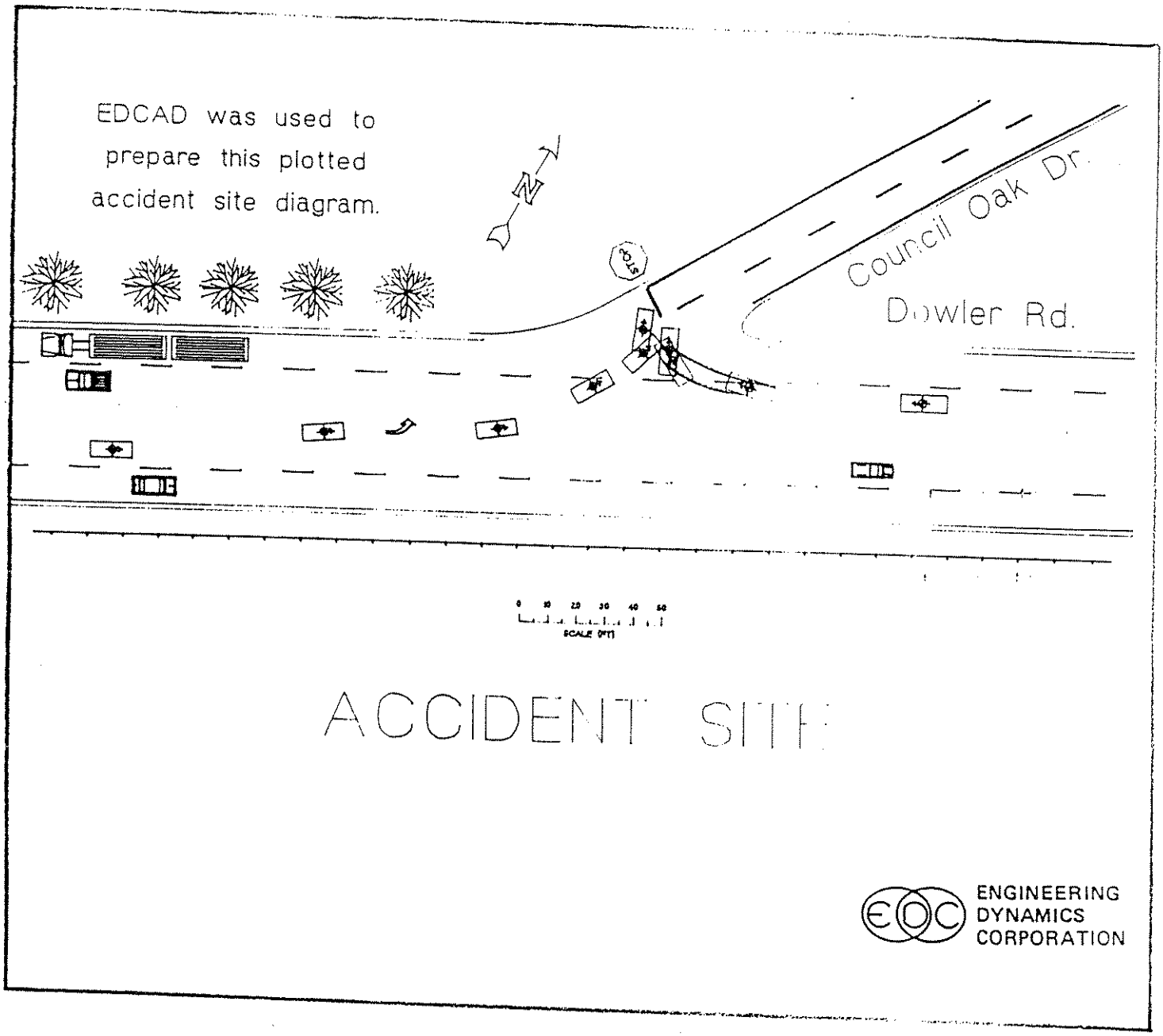

Figure 6.

Computer-generated auto accident-site drawing produced by EDCAD. Courtesy of Engineering Dynamics Corporation, Lake Oswego, Oregon.

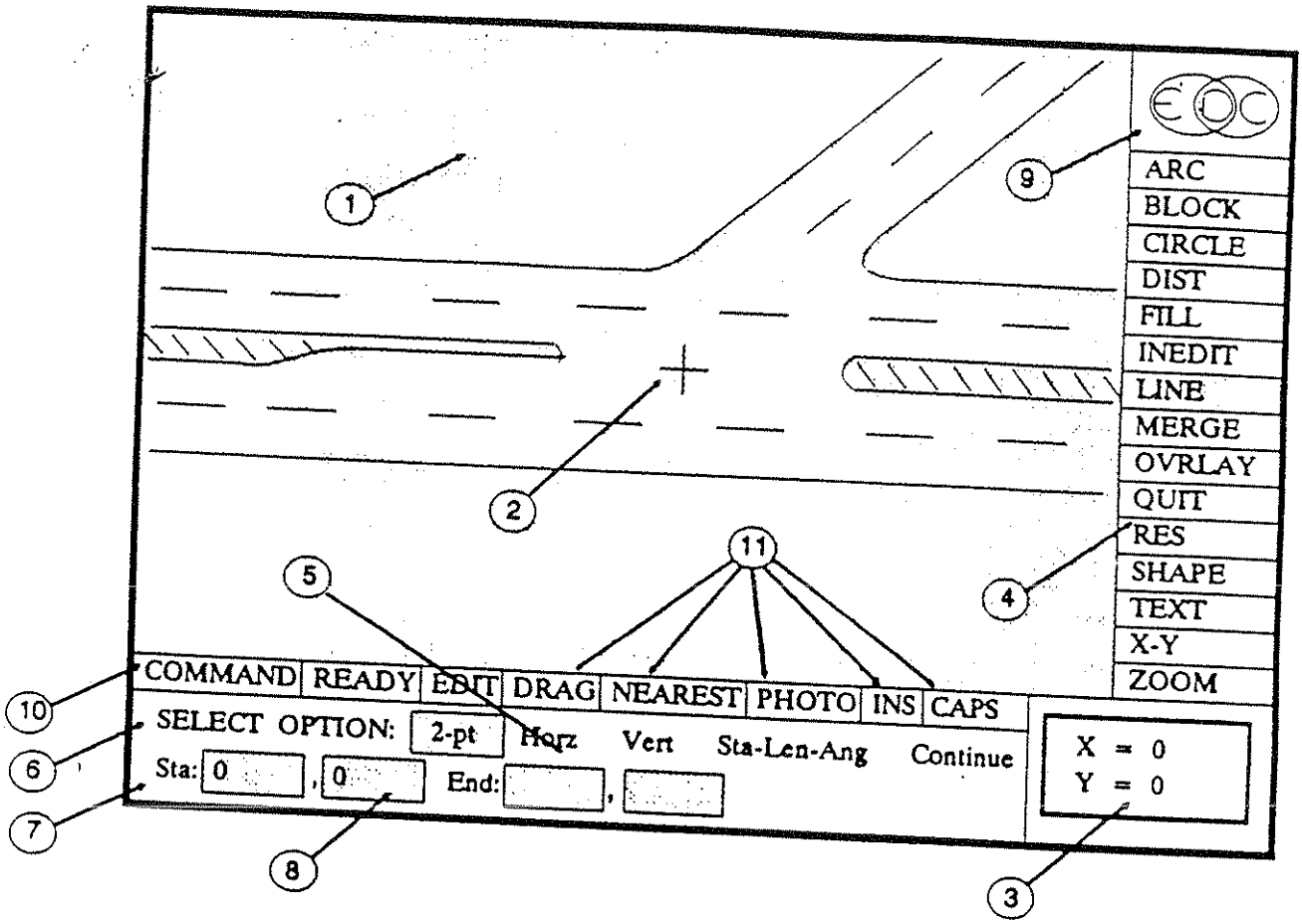

Figure 7.

Drawing of EDCAD display during creation of computer-generated accident-site diagram to illustrate command boxes and other computer input functions used to generate the illustration. Courtesy of Engineering Dynamics Corporation, Lake Oswego, Oregon.