
Jack W. Fleming
A GUIDE TO THE USE OF COMPUTERS TO ESTIMATE DAMAGES IN COMPLEX LITIGATION

by JACK W. FLEMING*

INTRODUCTION

The computation of damages in a multifaceted lawsuit is a task which can perplex even the most talented litigation attorney. Oftentimes liability or entitlement to damages can be easily demonstrated, whereas the measurement of the amount of damage sustained proves a more formidable task. Though a precise computation of damages is not generally required, the plaintiff must provide the court with some "reasonable basis" for assessing damages.1 Courts draw a distinction between a just and reasonable estimate of damages based upon relevant data and verdicts based upon speculation or guesswork.2 As the United States Supreme Court stated in the landmark case of Story Parchment Co. v. Paterson Parchment Paper Co.:

Juries are allowed to act upon probable and inferential as well as direct and positive proof. And, when, from the nature of the case, the amount of the damages can not be estimated with certainty or only a part of them can be so estimated, we can see no objection to placing before the jury all the facts and circumstances of the case, having any tendency to show damages, or their probable amount; so as to enable them to make the most intelligent and probable estimate which the nature of the case will permit.3

In the same vein, the Supreme Court has declared that where the wrongful conduct of the defendant has rendered difficult the ascertainment of damages suffered by the plaintiff, the defendant must bear the risk of the uncertainties which his own conduct cre-

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ated.\textsuperscript{4} Even so, when the existence of damage is uncertain or speculative, the plaintiff may be limited to the recovery of nominal damages.\textsuperscript{5}

The role of the attorney is to place sufficient facts and circumstances before the trier of fact to enable a reasonable calculation of damages. Since the events that give rise to lawsuits are often complex, it is sometimes difficult to adequately quantify the damages incurred through verbal or pictorial representations. This is especially true in technically complex matters, where a large volume of documents and a massive amount of statistical cost data may exist.

A potential solution to the dilemma faced by the attorney seeking to make an effective damage presentation to the fact finder is to develop a data processing system to assist in calculating damages. Conceptually, this entails utilization of a computer as a storage vault for a voluminous amount of information, which is then transformed by the application of an accepted methodology into an easily understandable display of the damages sustained.

There are a number of advantages in utilizing a computerized data base to estimate damages. First, it permits the storage and manipulation of far more information than manually possible. The speed and accuracy with which the computer can process data may enable an advocate to make certain damage calculations that otherwise would not be possible due to the sheer magnitude of the information involved.

Second, a computer eliminates the need to continuously refer to the original documents. Though the originals should be accessible for the purpose of verifying the accuracy of the data base, once verification is completed the computer enables the litigant to obtain far more efficient access to relevant information, in addition to decreasing storage space requirements.

Third, the computer, if properly employed, can become a powerful analytical tool and will allow a high degree of sophistication in the analysis of damages. By using a data processing system, relationships between various events may be revealed which otherwise would not be readily apparent. It is conceivable, for example, that through the analysis of statistical data, certain cause and effect relationships may emerge that will aid in the proof of key issues in the case.

Finally, a well conceived computer system enables the litigant

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4. Bigelow v. RKO Radio Pictures, Inc., 327 U.S. 251, 265 (1946); Western Geo-
physical Co. v. Bolt Assoc., 584 F.2d 1164, 1173 (2d Cir. 1978).
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to vastly simplify the presentation of evidence. Instead of having to introduce extensive documents and to rely upon verbal testimony of numerous witnesses, the information pertinent to damages may be condensed into a computer output summary with, perhaps, an accompanying chart or graph. In addition, if the opponent is given notice of the existence of the computer system far enough in advance of trial so as to permit him an opportunity to test its reliability, it may be possible to obviate the need for much of the foundational evidence otherwise required.

Thus, a computer system can offer many advantages in sophisticated litigation concerning trial presentation of damages. It is equally clear, however, that only certain cases demand this degree of precision. Even after a decision is made to employ a computer in this manner, there are a number of pitfalls to the successful application of such a system of which the litigant must be aware and take precautions to avoid. The remainder of this article will deal with the factors that an attorney should consider in deciding whether to use a computer in estimating damages, and the safeguards that can be observed to ensure the successful operation of a computerized system of this nature. Additionally, in an effort to create a better understanding of this concept, three practical applications of computers in the calculation of damages are also discussed.

I. WHEN A COMPUTER SHOULD BE USED TO ESTIMATE DAMAGES

A variety of factors must be considered when determining whether a data processing system is appropriate for estimating damages. The first question is whether the case is sufficiently complex to justify such a system. There are two major factors which must be considered. First, one must determine the volume of relevant information to be processed. In this regard, some thought should be given to whether an expert will be able to manage the information effectively if a manual system is chosen.

Second, one must consider the degree of sophistication required in the analysis of the damage issues. If it is likely that the analysis will involve more than routine calculations, a computer system may be desirable. In many instances, a technical expert may have to experiment with the data by varying the underlying assumptions and observing the results before arriving at a final conclusion. This capability may not be possible without a computer.

Another consideration in deciding whether a computerized data base is feasible is the cost of the system. Because of the numerous safeguards necessary to ensure the reliability of the final product, many unanticipated expenses will likely occur in the development
of the system. An experienced attorney or data processor will be able to accurately forecast the expected costs at the outset of the project. By obtaining an estimate of the total expected cost, the attorney will be able to make a realistic determination as to whether the projected expenditures are within the practical, budgetary limitations of the litigation.

Finally, one must consider the time necessary to develop and implement the computer system. In addition to the time required to manually enter the information into the computer, it may take months to edit and correct the data. Considerable lead time may also be necessary to write the necessary programs. Moreover, the expert may alter the approach of the analysis after reviewing the character of the computerized data, requiring new programs to be written. The time required to develop new computer programs and to analyze the results is often vastly underestimated. It is advisable, therefore, to make a realistic time estimate at the outset of the project, in order to avoid impeding the orderly development of the case.

In summary, computers can best be utilized to estimate damages in relatively complex cases where manual systems are inadequate. Provided that the cost and time estimates for developing the system are within the realistic constraints of the case, a computerized system can go far in giving the practitioner a highly sophisticated analytical tool for estimating and presenting damages.

II. SAFEGUARDS TO BE EMPLOYED IN A COMPUTER SYSTEM DEVELOPED TO ESTIMATE DAMAGES

There are two chief requirements in a computer-based system developed to estimate damages: (1) the information fed into the computer must be accurate and reliable; and (2) the final product, consisting of computer output summaries obtained with the aid of specially devised programs, must satisfy all evidentiary requirements for admissibility. To ensure these results, there are a number of safeguards that must be employed.

Initially, one should recognize that the need for safeguards is accentuated by the number of informational transmissions which occur between the original documents and the final computer output. Under most circumstances, the finished product will be four or five generations removed from the original documents. In addition, five classes of individuals will normally provide human input to the process.

In the typical computer system, the first step in the data collection process is the transcription of certain pieces of information from documents onto specially prepared coding sheets. This proce-
dure is normally accomplished by data coders trained in this type of work. Next, the information from the coding sheets is keypunched by trained operators onto computer cards for input to the computer. Following this, the cards are processed by a computer operator, and the information is transferred onto a magnetic tape, drum or disk for storage. Then, computer programs written by data processing specialists are used to manipulate the information in the desired manner to produce a computer output. The output can consist of a duplication of the information inside the computer, a summary of that information or the results of the manipulation of input data by the application of a methodology developed by the expert. Finally, the information from the computer output may be transferred to charts or graphs in a form suitable for presentation at trial.

As a consequence, a computer-based system will usually require the inputs of data coders, keypunch operators, computer operators, computer programmers, and expert consultants, each of whom potentially can impact the quality of the end product. The computer itself can also malfunction and adversely affect the accuracy of the data base, though most computers have internal mechanisms designed to minimize the potential for this occurrence.

The need to take adequate precautionary measures is further emphasized by the Manual for Complex Litigation, which states that though the

use of a computer to facilitate preparation of a study would not detract from its admissibility . . . in weighing the value of machine analyses, it is essential to evaluate the competence and techniques of the people who have designed the operational methods of the computer and the accuracy and completeness of the data which the computer is directed to manipulate.6

The incidence of human errors in a computer system can be minimized, but never eliminated. As a practical matter, the cost of eliminating additional errors rises significantly as the number of undetected errors is reduced. Consequently, a small measure of error is unavoidable and must be tolerated. It is the responsibility of the attorney to determine what measure of error will be acceptable and will not jeopardize the accuracy or credibility of the system as a whole.

In the future, it may be possible to eliminate one or more of the above-described operations, thereby decreasing the possibility of error. Ways have been devised, for example, to enter information into the computer without keypunching it onto cards. Insofar as the typical document is concerned, however, there may be no substitute for

transcribing the information by the use of a computer terminal or keypunch machine.

As for specific safeguards, the first area of concern should be the data-coding process itself. As a general rule, human error in transcribing information from original documents is the single, largest source of error. Consequently, considerable care should be taken to train the data coders properly and to acquaint them with the information to be transcribed. Detailed written instructions should be drafted and reviewed with each individual.

In addition, the work of every data coder should be systematically sampled to ensure its accuracy. Records of the samplings and of the corrective measures taken to cure repetitive errors should be kept. Depending on the volume of information coded, it may be advisable to employ an expert to devise a scientifically tested, statistical sampling scheme. By doing this, the expert would be in a position to offer testimony as to the relative accuracy or confidence level of the transcribed data.\(^7\)

Furthermore, an individual with computer data-coding expertise should be assigned to supervise the coding operation. If any questions arise concerning the reliability of the data transcriptions, the individual who managed and supervised the data-coding phase of the project from its inception should be available to testify.

Several safeguards can likewise be observed in the keypunching of data. For example, the same information can be keypunched twice on separate cards, and the entries on each card compared by the computer for discrepancies. Alternatively, the keypunchers can verify all entries, meaning that each card is actually punched twice, with the machine alerting the operator if any of the verification punches vary from the original ones.

Once the data is entered into the computer, additional safety measures can be taken prior to commencing the damages analysis. Extensive computer edit programs can be designed to remove any extrinsically obvious errors in the data stream. For example, if a particular entry consists of the numerical months of the year, the computer can highlight any non-numerical entries, or numerical entries greater than twelve. These edit programs, by their nature, will cure a significant number of keypunching and data-coding errors, further enhancing the accuracy of the transcribed information.

Any data inputs to the computer will typically be stored in the

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\(^7\) An article entitled "How to Statistically Control the Accuracy of Computer-Generated Data Specially Prepared for Trial" is currently being prepared for publication by the author in conjunction with Dr. Eric M. Malstrom, Professor of Industrial Engineering, Iowa State University.
computer memory, and then transferred onto a storage device, such as a magnetic tape, drum or disk. Special care should be taken to ensure the continued accuracy of the information contained on the storage device. An attorney would be well advised to have at least one duplicate copy of the data stored in a secure place. Various factors such as room temperature, humidity and magnetic products can affect the quality of the information contained on keypunch cards or magnetized storage devices. Moreover, an ill-conceived computer program can alter the quality of the data base. As a result, it may be helpful to have a spare tape or disk kept intact throughout the course of the project to periodically verify the accuracy of the data upon which the damage analysis is based.

Another common source of error is the computer programs themselves. Almost all programs undergo a "debugging" process, during which most errors are removed. Sometimes all errors are not removed from the program, particularly if they are not apparent from an examination of the output. To eliminate computer programming errors, all programs should be verified using test data and test programs. These programs should simulate every operation which the computer will undertake. The test data should simulate every conceivable combination of data inputs, and yet be simple enough that the correct output can be determined manually. The computer programs can then be verified by comparing the manual solutions to those computed by the programs. As a further precaution, an independent computer programming specialist can be retained to examine and test each program. Inherent in the computer programming process, of course, is the hiring of a computer programming expert to testify about the validity of the programs. Ultimately, the reliability of the computer system may be judged by the credibility of such testimony, so it is important to exercise care in the choice of an expert in this area.

The judicial requirements for accuracy and reliability vary significantly from case to case. In the past, not all courts have insisted that proponents of computerized evidence adequately demonstrate the reliability of their data processing systems. Computer evidence has been admitted, for example, solely on the basis of a custodian's testimony that the records were made in the regular course of business by someone with a duty to accurately report the transaction. In another instance there was considerable question as to whether the opponent had sufficient notice and opportunity to cross-examine the expert regarding the reliability of the computer system, yet the

evidence was nevertheless admitted.\textsuperscript{9}

Judges, however, are becoming increasingly aware of the potential for errors in computer-generated reports. This growing attitude was reflected in Judge Van Graafeiland's dissenting opinion in \textit{Perma Research and Development v. Singer Company}:

Plaintiff offered the testimony of two expert witnesses in support of its claim that its anti-skid device could be made workable and failsafe. The first of these witnesses based his opinion upon experimental data supplied by the second, and the second secured all his data from some simulated formulas which he fed into a computer. The information upon which these formulas were based was hearsay, having been secured from still a third person. It was conceded by the witnesses that their conclusions were based upon the computer output. Indeed, neither of plaintiff's experts had ever seen plaintiff's device in operation or had tested it.

As one of the many who have received computerized bills and dunning letters for accounts long since paid, I am not prepared to accept the product of a computer as the equivalent of Holy Writ. Neither should a District Judge\textsuperscript{10}.

Though the above-described procedures will minimize the potential for error in a damage study, additional steps may be necessary to ensure the admission of the computer data into evidence at trial. In fact, the growing trend among courts is to require pre-trial disclosure of the underlying data and computer programs as a condition of admissibility. Though some courts have allowed the trial judge to exercise his discretion in admitting computer data without disclosure of the details in advance of trial\textsuperscript{11}, the better rule is that the opponent must have ample time and opportunity to examine the accuracy of the computer programs employed.\textsuperscript{12} The \textit{Manual for Complex Litigation} suggests in its Seventh Recommendation:

It is essential that the underlying data used in the analyses, programs, and programming method and all relevant computer inputs and outputs be made available to the opposing party far in advance of trial. This procedure is required in the interest of fairness and should facilitate the introduction of admissible computer evidence. This procedure provides the adverse party and the court with an opportunity to test and examine the underlying data on which the machine analysis is based, the program and outputs prior to trial.\textsuperscript{13}


\textsuperscript{10} \textit{Id.} at 121 (Van Graafeiland, J., dissenting).


\textsuperscript{12} United States v. Liebert, 519 F.2d 542, 547 (3rd Cir. 1975), \textit{cert. denied}, 423 U.S. 985 (1975).

\textsuperscript{13} \textit{Manual for Complex Litigation} § 2.714, at 142 (1977).
At a minimum the proponent of the evidence must give the opposing party an opportunity to conduct full discovery concerning (1) the validity of the underlying data, (2) the method for selection of the data, (3) the validity of the programming, (4) the reliability of the computer itself, and (5) the accuracy of the results in light of the assumptions and techniques employed. Some authorities suggest that even the reliability verification procedures should be made available, along with the systems flow charts detailing the nature of the programs.\(^\text{14}\)

Although disclosure of computer-generated data in advance of trial may be inconvenient, advance disclosure can be turned to an advantage. If the opponent is given ample time to examine the data and to raise objections, he may be estopped from attempting to exclude the computer data from evidence at trial. Moreover, the proponent may be successful in arriving at a stipulation with the opposition to guarantee the admissibility of the information without objection. By eliminating the burden of providing the court with extensive foundational evidence, the presentation of damages can be vastly simplified.

One word of caution is in order regarding the premature disclosure of computer-based data. Though there is a dearth of authority on this point, it has been suggested that an adverse party may, after obtaining computer summaries well in advance of trial, use the information in support of its own case. Regarding computer information relating to the issue of damages, it is clear that the opponent may introduce the testimony of experts to refute the proponent's claims. In so doing, the conflicting testimony of the opponent's experts could be utilized to demonstrate the amount of the actual damages incurred. Consequently, one is well advised to experiment with the data to ensure its favorability prior to disclosure to the opposition. It may prove worthwhile to conduct preliminary tests on portions of the data as it is being coded to ensure that a favorable damages study will be obtained. In this way, considerable time, expense and energy may be saved in the development of the case.

III. EXAMPLES OF COMPUTER APPLICATIONS IN ESTIMATING DAMAGES

In some cases a computer need only be used as a storage facility and assimilator for a large volume of data. This is usually true where the method of calculating damages is readily apparent, and it is necessary merely to summarize or amass the relevant informa-

tion. Other cases may demand a higher degree of sophistication in estimating damages. The following discussion focuses on three sophisticated damages methodologies, which have been greatly enhanced by the advent of the computer: (1) the Critical Path Method (CPM) in construction contracts, (2) learning curves in manufacturing contracts, and (3) computer simulation models in antitrust disputes.

The Critical Path Method (CPM) of scheduling is a device utilized by contractors to plan, schedule, and control work activities on construction projects in order to complete the project in the quickest and most economical fashion. The theory of CPM is that by placing all necessary activities of a construction project in the order in which they must be performed, and estimating the reasonable time to complete each activity, the shortest or optimal completion time can be computed. As a CPM is used to schedule a project, it can also be employed to measure disruption and delay in construction contract litigation. While historically there has been judicial reluctance to accept CPM analysis as persuasive evidence of delay and disruption, CPM is now widely recognized as a competent evidentiary tool.\(^\text{15}\)

In order to conduct a CPM study, the “as bid” and “as built” schedules must be reconstructed. The “as bid” represents the original planned schedule, whereas the “as built” demonstrates what actually occurred, including any adjustments made to the schedule during the course of the contract. A vital part of the investigative research in constructing the “as built” schedule consists of determining the actual length of time taken by each activity in the project. Once this work is completed, the information from the “as bid” and “as built” schedules can be fed into a computer. By utilizing a computer program specially designed for a CPM study, the activities which prevented timely completion of the construction project can be pinpointed, and the extent of the delay caused by each activity ascertained. Of course, not all activity delays will cause a delay in the completion time. Only those activities which lie on the “critical path” will actually impact timely completion of the job.

An additional piece of information is needed to complete the CPM study—namely, a designation of liability for each activity delay. This information will, by its nature, rest upon the factual evidence in the case. Once liability is fairly apportioned, a properly conducted CPM study will allow for a precise determination of the delays incurred as a result of the acts of the opponent. Once the

amount of compensable delay is ascertained, the damage sustained usually can be quantified without undue effort.

A key advantage in utilizing a computer-based CPM system is its flexibility in formulating calculations at trial. There may be some activity delays, for example, upon which the CPM analysis is based that cannot adequately be proven to be the responsibility of the opposing party. With the speed and accuracy of a computer system, calculations of compensable delays can be readjusted quickly in the midst of trial to take into account any inadequacies of factual proof or unexpected testimony.

A second application of computers in estimating damages involves the use of learning curves in manufacturing contract claims. It is a widely accepted principle that the speed or efficiency with which a task is performed increases, within certain parameters, as the task is repeated. Many industries have made use of this principle by studying particular assembly line operations and computing a learning curve percentage or "efficiency factor," which can be used to estimate costs for a high volume manufacturing contract. Also, some companies have computed certain learning curve factors from their records which historically have been experienced in their facilities. If a claim is asserted which involves a loss of labor efficiency due to disruptions in a manufacturing contract, learning curves provide an ideal mechanism for estimating those disruptive costs.

There are only two pieces of information which need to be known to conduct a learning curve analysis—the labor expended per accounting period, and the units completed (including work-in-process) during those same accounting periods. If this information is input to a properly programmed computer, the actual learning experience of the workers on the disputed contract can be determined. Then, by using the appropriate industry-accepted or company-proven learning curve factor as a comparison, the attorney can obtain an accurate estimate of the loss of labor efficiency caused by the disruptions.

It is imperative, of course, that the litigant demonstrate by a preponderance of evidence that the disruptions resulted from the acts of the opposing party. Various factors, such as design deficiencies and material shortages usually account for disruptions, but may be difficult to prove. This proof can be eased, however, by a learning curve study. This type of computer-based study can disclose, for example, at what stage in the contract the efficiency loss occurred, thereby pinpointing, at least by implication, the cause of the delay and disruption.

As with the CPM, the loss of labor efficiency method of proving
delay and disruption has gradually gained acceptance in the courts. Courts have recognized that when manufacturing costs increase due to defects in design specifications, learning curves can be used to demonstrate what the costs should have been had the design defects not existed.\(^\text{16}\) As a result, learning curve techniques, in conjunction with computerized data processing systems, present a viable method for estimating damages in lawsuits arising out of manufacturing contracts.

A third application of computers in estimating damages involves the use of computer model simulation. A computer model takes data representing actual events, and manipulates it according to an established set of rules designed to simulate the real world. Computer-aided simulation models have traditionally been employed in the study of business problems. Econometric models are commonly used to predict what the economy will do. Other models, simulating the environmental impact of pollutants discharged by industry, have guided the government in establishing pollution emission standards.\(^\text{17}\)

Computer-aided simulation models are becoming an increasingly important force in antitrust litigation. A number of models which are ideally suited for computer applications have been designed to estimate lost profits due to certain anticompetitive acts.\(^\text{18}\) In a price-fixing case, for example, one may be able to simulate the market for the product in issue, so that lost sales resulting from artificially fixed prices can be determined. Damage estimates in cases of this type are by their very nature imprecise. The application of computer models can provide a greater degree of exactness in the derivation of antitrust damages.

The advantage of a simulation model is its ability to portray a complicated situation better than any verbal description could hope to do. A model can disclose relationships between various events which might not otherwise be apparent. Also, a model makes it possible to consider all relevant factors simultaneously in the solution of the problem.

On the other hand, no model can totally replicate a real life situation. In setting up a model, one must exercise subjective judgment in choosing the relevant factors to be included in the system, and in determining the relative weight to be accorded to each. The extent to which this process accurately resembles the real world, of course,

\(^{16}\) Teledyne-McCormick-Selph v. United States, 588 F.2d 828 (Ct. Cl. 1978).
\(^{17}\) Cleveland Elec. Illuminating Co. v. E.P.A., 572 F.2d 1150 (6th Cir. 1978).
determines the accuracy of the model. As Judge Van Graafeiland stated in this dissenting opinion in *Perma Research*:

Authorities in the field of computer research acknowledge that simulation is essentially an experimental problem-solving technique. . . . Simulation is make-believe—it's a game—but it should have some solid relationship with the real world. . . . A computer model is valid only insofar as it enables us to make valid inferences about the real world system being simulated.  

In *Perma Research* and other cases, litigants have successfully used the results of a computer simulation as the basis for expert testimony.  

Though there are few reported decisions dealing with the admissibility of computer-aided simulation models, the courts seem more than willing to accept these models, provided that they are carefully constructed.

**IV. CONCLUSION**

A neatly printed computer output, if properly utilized, can be a highly persuasive piece of evidence in the presentation of damages at trial. A computer data processing system can be particularly useful in the sophisticated or technically complex case, where a massive amount of information must be analyzed. Certain safeguards must be taken, however, to ensure the reliability of the computer-based information and its admissibility at trial. If adequate precautions are observed, the computer can be a powerful analytical tool with almost endless potential in the analysis and estimation of damages. Moreover, a computer system can assist in streamlining the presentation of damages at trial, thereby allowing for greater clarity and persuasiveness.

