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Environmental Law Advisory

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Admissibility of Expert Opinion Based on Computer Modeling – What Does *Daubert* Require?

Expert testimony inevitably plays a central, sometimes decisive, role in the outcome of environmental cases. Experts typically testify about such issues as source identification, travel time, direction and extent of migration, potential pathways and duration of exposure, relative contributions of multiple overlapping sources of contamination and/or exposure, and effects of exposure on human health.

Use of computer software to create models to explain and predict the behavior and effects of chemicals at a specific site is now commonplace, particularly in the fields of hydrogeology and toxicology. Admissibility of expert opinions based on computer models therefore has received much recent attention from federal courts.

The evolving doctrine of *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 509 U.S. 579 (1993), requires scientific expert opinion to be both scientifically valid and applicable to the facts of the case. Because the doctrine can lead to outright exclusion of a scientific expert, the snares and pitfalls of handling such experts have never been more treacherous. Knowing where those dangers lie and how to avoid them can make the difference between winning and losing.

This Advisory addresses some major recent applications of the *Daubert* doctrine to computer modeling, with a special focus on two problems: (1) expert reliance on other experts to create a model and (2) the handling of formulas and variables in modeling.

Daubert Basics

To be admissible under Federal Rule of Evidence 702, expert testimony must come from a qualified expert, assist the trier of fact, and meet three foundational requirements: the testimony must be (1) based on sufficient facts or data, (2) the product of reliable principles and methods, and (3) a reliable application of principles and methods to the facts of the case. The *Daubert* doctrine focuses primarily on the second and third foundational requirements: whether the expert's reasoning or methodology is scientifically valid and whether that reasoning or methodology can be properly applied to the facts at issue. In short, *Daubert* is about the "reliability" of the scientific principles and methods at issue and about the adequacy of the "fit" between that science and the facts of the case.

To determine the reliability of a scientific opinion, the court may look at any relevant factor, but courts pay particular attention to four factors named in *Daubert*: whether the expert's theory has been or can be tested; whether it has been subjected to peer review and publication; the known or potential error rate of the technique; and whether the technique is generally accepted in the scientific community. *Daubert*, 509 U.S. at 593-94.

The *Daubert* doctrine places the judge in the role of a "gatekeeper" who can bar the admission of scientifically unreliable evidence, but the judge must not make ultimate conclusions about the persuasiveness of the evidence. "Vigorous cross-examination, presentation of contrary evidence and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky, but admissible evidence." *Daubert*, 509 U.S. at 596. The *Daubert* doctrine calls for *exclusion* of an expert's testimony when the risk of jury confusion and prejudice is so great that these traditional and appropriate means of attack will not suffice.

Use of Computer Models by Environmental Experts

Computer models are often efforts to simulate physical processes, especially when the process is not susceptible of direct observation or physical experiment. Because environmental processes such as contaminant fate and transport are often complex and hard to observe, environmental experts frequently use computer models to develop or validate their testimony. *Daubert* questions inevitably follow.

At a basic level, a computer model consists of one or more computer programs designed to perform a series of mathematical operations. These programs generally must be written, or at least adapted, for the particular case. And this need to write or adapt the software creates opportunities for coding errors, both conceptual and mechanical. The formulas to be applied must themselves have a sound scientific basis, and they must be applied in a scientifically appropriate sequence. They must contain the appropriate variables, appropriately defined, with no critical variable left out and no extraneous variable included that might foul up the calculation.

Even if the design of the program is scientifically reliable – all of the formulas are well-thought out, logically sequenced, and based on sound science – the software itself may not execute the operations properly. If the code works properly and the model is a properly working, scientifically reliable "machine," the underlying data fed into that "machine" must be handled right too. Are the sources of the data appropriate for the variables defined in the program? Are the data complete and, if not, what approach was taken to the missing data? Was the entry of data handled carelessly? If the data are mishandled, "garbage in," as the saying goes, likely will yield "garbage out."

Finally, even if both the computer program and the underlying data pass muster, the question remains whether the results generated by the program actually "fit" the relevant legal issues in the case. If the model, for example, projects a likely causal relationship between exposure to a toxic chemical and a particular liver disease for white males over 65, does that say anything at all about the relationship between exposure to that chemical and a different liver disease found in a ten-year-old African-American female plaintiff?

Daubert potentially requires a court to consider all of these issues in deciding whether to admit scientific testimony.

Application of *Daubert* to Computer Models

Courts analyze a *Daubert* challenge to a computer model by considering the reliability of the model itself, as well as the reliability of the expert's application of the model. Recent case law addresses important issues that arise when experts apply environmental computer models: (1) experts relying on other experts; and (2) identifying and determining values for variables in a model.

Testifying Expert Relying on Another Expert's Modeling Expertise

The *Daubert* questions of "reliability" and "fit" are conceptually distinct from the question whether an expert is properly qualified to present the intended testimony, and whether that testimony will assist the trier of fact. For example, regardless how qualified an expert may be, a party cannot rely on qualifications alone to demonstrate that the expert's testimony is sufficiently reliable. Nonetheless, a court may give a very well-qualified expert the benefit of the doubt.

The scope of an expert's qualifications can influence a *Daubert* challenge in another way as well. An environmental expert testifying based on a computer model may possess expertise in the relevant physical processes, but not in the creation of the model itself. As a result, the expert may have had to rely in part on the expertise of a computer modeler to use a scientifically reliable methodology, and the reliability of the testifier's final conclusions may hinge on the other expert's choices.

"An expert witness is permitted to use assistants and normally they need not themselves testify." *Dura Auto. Sys. of Ind., Inc. v. CTS Corp.*, 285 F.3d 609, 612 (7th Cir. 2002). The opposing party can depose them to test the work they did, and the expert witness can be asked if he supervised them carefully and whether his relying on their assistance was standard practice in his field. If so, Federal Rule of Evidence 703 allows the expert to rely on the assistants, and their work need not be introduced in evidence.

The same rule may apply to the situation when a testifying expert is relying on another expert's opinion. Courts have held consistently that experts can rely on the opinions of other experts in reaching their conclusions, provided the other expert's underlying methodology is also reliable. *See Nutrasweet Co. v. X-L Engineering Co.*, 227 F.3d 776, 789-790 (7th Cir. 2000) (affirming admission of expert testimony about source of groundwater contamination where expert used soil degradation data obtained from another expert). Under *Daubert*, courts have limited the ability of one expert, in effect, to testify for another. In the words of Judge Posner in *Dura*, "A scientist, however, well-credentialed he may be, is not permitted to become the mouthpiece of a scientist in a different specialty. That would not be responsible science." 283 F.3d at 614.

In *Dura*, the plaintiff relied solely on a hydrogeologist to testify about the area from which groundwater that contaminated a city well field could have flowed. The witness was offered to address two issues: (1) the map of the "capture zone" – the area from which the contamination could have flowed – and (2) if the defendant's plant was in the capture zone, how much of the contamination in the well field was attributable to groundwater that had flowed from under the plant. For his opinion on the first issue, the hydrogeologist relied on a computer model of the groundwater flow, even though he was not himself expert in computer modeling and was not competent to judge whether the modelers had made scientifically correct choices. The trial judge excluded the hydrogeologist's testimony, and the Seventh Circuit affirmed. *Dura Auto. Sys. of Ind., Inc. v. CTS Corp.*, 285 F.3d 609, 615 (7th Cir. 2002).

The lesson of *Dura* is that a party planning to offer an expert witness needs to be careful in identifying the scope of the witness's expertise and the relation of that expertise to the opinions the expert will give. If the expert is not merely exercising her own expertise in supervising subordinates, but instead is relying on the scientific expertise of others as a ground of her opinion, then those other experts should be disclosed; they should submit expert reports if the applicable rules require reports; and they should be prepared to testify at a *Daubert* hearing about the reliability of their methods.

Identifying and Calculating Variables in Computer Models

Often a party contesting the reliability of a computer model concedes the scientific reliability of the overall computer program, but challenges either the expert's failure to include or exclude certain variables, or the expert's handling of a variable. The degree of *Daubert* scrutiny that this issue receives may depend on such factors as the transparency of the expert's assumptions and methodology, the importance of the variable to the model and the model to the expert's opinions, and the extent to which the expert's handling of the variables is inconsistent with scientific literature or established standards.

The Eleventh Circuit takes the view that failure to include all available variables generally goes to the probativeness of a model, not its admissibility. *See Quiet Technology DC-8, Inc. v. Hurel-Dubois UK Ltd.*, 326 F.3d 1333, 1345 (11th Cir. 2003). Thus, in *Quiet Technology*, there was no dispute about the scientific validity of "computational fluid dynamics" software or about the expert's use of certain types of aerodynamic data in connection with the software. The expert's "methods and results" were discernible and "rooted in real science," and therefore were empirically testable and susceptible to effective cross-examination. *Id.* at 1346. The challenges to the expert went to the accuracy of his results not the validity of his use of the model.

Eighth Circuit cases have both rejected and sustained a *Daubert* challenge to the handling of variables in an otherwise valid model. Plainly an expert is on fairly safe ground using a model that is well-accepted in the field and is not the sole basis for his ultimate conclusion . In *United States v. Dico, Inc.*, 266 F.3d 864, 870-871 (8th Cir. 2001), the government's hydrogeologist Robertson testified that TCE contamination originated on Dico's property. Dico argued that Robertson's methods were unreliable because he excluded evidence of alternative sources of contamination from his computer model. On appeal, the court held that the model itself was reliable – it was sanctioned by EPA, in standard use by hydrogeologists, and used by Dico's own expert. Furthermore, the model did not form the basis of Robertson's conclusion about the origin of contamination. He had merely used it to analyze the capture zones of remediation wells on Dico's property. Thus, any problems with the data put into the model were "without consequence as to the validity of his analysis of alternative sources for the contamination."

Smith v. BMW, 308 F.3d 913, 921(8th Cir. 2002), on the other hand, illustrates both the risk of wholesale reliance on a computer model without adherence to scientific standards and the risk that the testimony of one's own expert may rehabilitate the methodology of an expert whose testimony failed the *Daubert* test. *Smith* was a product liability case involving an airbag that allegedly malfunctioned in an automobile accident. Plaintiff's accident reconstruction expert, Williams, used a computer model to calculate the "barrier equivalent velocity" of the accident – testimony necessary to show that the velocity was high enough to cause a properly designed airbag to deploy during the accident. The *Daubert* challenge went to Williams' handling of two essential inputs for the computer program: the "principal direction of force" and the amount of "frontal displacement" of the car.

First, according to a defense expert and the trial judge, Williams' value of 20 degrees for direction of force was inconsistent with Williams' own theory of the case because it could not generate the counterclockwise rotation of the car that Williams relied on to explain the displacement of the car's front end. On appeal, however, the court concluded that Williams had actually testified to a direction of force *no greater than* 20 degrees and had reached this conclusion based on an investigation of witnesses, the vehicle, and the accident scene. Values less than 20 degrees would increase both the barrier equivalent velocity and the counterclockwise rotation, strengthening plaintiffs' case. Thus, any flaws in Williams' approach to direction of force went to the weight of the evidence, not its admissibility.

Second, in measuring displacement, Williams assumed that the car was rectangular when in fact it was not, and scientific literature called for use of an exemplar that reflected a vehicle's actual dimensions rather than a rectangle. On this point, the Eighth Circuit affirmed an exclusion of Williams' testimony because Williams provided no evidence explaining why his measurements using the rectangle would be accurate. Since the computer program could not calculate barrier equivalent velocity without the displacement measurements, Williams could not testify as to the velocity either.

Although Williams was not permitted to give this critical testimony about velocity, the appellate court noted that this gap in plaintiffs' evidence did not warrant summary judgment. A *defense* expert had corrected Williams' displacement measurements and run the program with the corrected measurements. There was evidence that the corrected velocity calculated by the program was high enough to trigger release of an air bag.

Conclusion

The lesson of these cases is that the expert relying on a computer model should generally be explicit about her assumptions and her methods – a testable methodology and results will be likelier to get to the jury. Furthermore, exclusion is less likely if the expert grounds her opinion in sources of evidence in addition to the model. Also, unless the case requires the use of novel techniques, the expert should generally avoid applying the model in a fashion that is inconsistent with the scientific literature or with established scientific practice. Finally, in responding to an opposing expert who uses a model, a party should be careful in deciding whether its own expert should merely criticize the opponent's methodology or instead should offer calculations of her own; such calculations may buttress the opponent's case.

Computer models are admissible in evidence and experts have used them effectively, but they must be built carefully based on accepted scientific models, using assumptions clearly grounded in the specific site conditions, and defended by a qualified expert who can demonstrate proper application of formulas and variables.

For further information about the role of computer modeling in expert testimony, please contact:

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