

Experts, Liars, and Guns for Hire: A Different Perspective on the Qualification of Technical Expert Witnesses

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Gentlemen of the jury, there are three kinds of liars,—the common liar, the d—d liar, and the scientific expert.¹

INTRODUCTION

Expert witnesses have long been a disparaged lot. While most experts probably are not blatant liars, they are arguably conduits of hearsay² and other unreliable evidence. Furthermore, they may be willing to conform their opinions to suit the needs of the highest bidder.³ Many commentators have suggested approaches to solve these problems and to bolster the reliability of expert testimony. Yet much of the discussion focuses on the substance of expert evidence. This Note takes a step back and questions the expert qualification process.

Two preliminary considerations are in order. First, this Note rests on the simple assumption that increased diligence during the qualification of experts will ultimately increase the reliability of opinion testimony. Of course, many times, experienced judges deftly resolve the qualification issue. The qualification issue, however, may be more difficult to resolve when a judge is faced with testimony cast in the unfamiliar language of science and technology. Second, given the increasing role technology plays in evidentiary matters, this Note addresses the narrow issue of technological expert qualification.

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1. William L. Foster, *Expert Testimony—Prevalent Complaints and Proposed Remedies*, 11 HARV. L. REV. 169, 169 (1897) (quoting a trial lawyer's closing remarks after sensing defeat because of expert testimony).

2. See, e.g., Ronald L. Carlson, *Experts as Hearsay Conduits: Confrontation Abuses in Opinion Testimony*, 76 MINN. L. REV. 859 (1992) [hereinafter Carlson, *Hearsay Conduits*]; cf. David L. Faigman, *Commentary: A Response to Professor Carlson. Struggling to Stop the Flood of Unreliable Expert Testimony*, 76 MINN. L. REV. 877 (1992) (noting that policing underlying data is inconsistent with the liberal standard for opinion testimony).

3. See Ronald L. Carlson, *Policing the Bases of Modern Expert Testimony*, 39 VAND. L. REV. 577, 587 (1986) [hereinafter Carlson, *Modern Expert Testimony*]. One commentator writes that "a Ph.D. can be found to swear to almost any 'expert' proposition, no matter how false or foolish." *Id.* (quoting Peter Huber, *Safety and the Second Best: The Hazards of Public Risk Management in the Courts*, 85 COLUM. L. REV. 277, 333 (1985)).

Technology interposes our lives with benefits while requiring us to deal with its concomitant burdens. Freon-based air conditioning, for example, cools sweltering days while also depleting the ozone layer. Likewise, nuclear fission provides both an abundance of energy and a potential for catastrophe. Technology similarly impacts our judicial system. The debate over novel scientific evidence attests to this proposition.⁴ Unfortunately, science does not pause for legal solutions to the problems it poses. With increasing frequency, judges are asked to handle technological issues.⁵ It is questionable, however, whether judges and juries are equipped to do so.⁶

Frequently, our legal system relies on expert witnesses to enlighten and elucidate the fact-finder as to otherwise arcane topics. This reliance on expert testimony causes several problems.⁷ First, reliability problems follow from the need to use experts: Experts can be the source of questionable evidence;⁸ they are free to reach conclusions based on extra-record evidence;⁹ and they can deter a meaningful evaluation of non-opinion evidence when the trier of fact overvalues expert testimony.¹⁰ Second, the bar and bench often do not select and qualify experts so as to minimize the negative effects of expert

4. The Supreme Court recently addressed the subject of scientific evidence. The Court held that the common law general acceptance test for the admissibility of scientific evidence was superseded by the enactment of Rule 702 of the Federal Rules of Evidence. *Daubert v. Merrell Dow Pharmaceuticals*, 113 S. Ct. 2786 (1993).

5. See David L. Bazelon, *Coping with Technology Through the Legal Process*, 62 CORNELL L. REV. 817, 817 (1977) (indicating that technology has precipitated evidentiary problems for judges). Jurisdictions faced with DNA identification evidence have approached the admissibility of such proof differently. Compare *Cobey v. State*, 559 A.2d 391 (Md. Ct. Spec. App. 1989) (noting that DNA identification evidence is expressly declared admissible in criminal proceedings by statute), *cert. denied*, 565 A.2d 670 (Md. 1989) with *State v. Schwartz*, 447 N.W.2d 422 (Minn. 1989) (holding that noncompliance with industry standards bars admission of conclusions based upon DNA identification). Additionally, computer animation or reenactments may be the source of technology-induced reliability questions that judges must also answer. "[C]omputer simulations are simplified models of reality that include only some of the variables that shaped an event. A simulation is only as good as its underlying assumptions." Robert Garcia, "Garbage in, Gospel out": *Criminal Discovery, Computer Reliability, and the Constitution*, 38 UCLA L. REV. 1043, 1080 (1991).

6. Bazelon, *supra* note 5, at 822; see also John W. Wesley, Note, *Scientific Evidence and the Question of Judicial Capacity*, 25 WM. & MARY L. REV. 675 (1984).

7. See generally PETER W. HUBER, GALILEO'S REVENGE (1991); MICHAEL SAKS & ROBERT VAN DUIZEND, THE USE OF SCIENTIFIC EVIDENCE IN LITIGATION (1983); Edward R. Becker & Aviva Orenstein, *The Federal Rules of Evidence After Sixteen Years—The Effect of "Plain Meaning" Jurisprudence, The Need for an Advisory Committee on the Rules of Evidence, and Suggestions for Selective Revision of the Rules*, 60 GEO. WASH. L. REV. 857 (1992); Carlson, *Hearsay Conduits*, *supra* note 2; Carlson, *Modern Expert Testimony*, *supra* note 3; Michael J. Wagner, *Expert Problems*, LITIG. 35 (1989).

8. Huber notes that:

[S]tandards for expert witnesses have all but disappeared. Today, virtually any doctor armed with a medical degree is qualified to testify. Sometimes he will be expected to assert that his opinion has a "reasonable basis," that it does not originate in chicken entrails or phases of the moon, but this is not much of a standard. [H]e may insist that he alone among doctors understands the importance or origins of certain symptoms. He may claim, in short, to be a new Galileo. The standards are almost equally loose for other, nonmedical experts.

HUBER, *supra* note 7, at 16; see also *infra* notes 76-77 and accompanying text. For a discussion of how an expert can be the source of hearsay evidence, see *infra* notes 78-89 and accompanying text.

9. "If of a type reasonably relied upon by experts in the particular field in forming opinions or inferences upon the subject, the facts or data need not be admissible in evidence." FED. R. EVID. 703.

10. See *infra* notes 86-89 and accompanying text.

testimony If an expert is able to assist the trier of fact in understanding technological evidence,¹¹ the question still remains whether that expert should be an engineer¹² or a technically-skilled witness.¹³

This Note argues—in the context of the Federal Rules of Evidence—that practitioners and judges need to make a distinction between engineers and other technically-skilled witnesses, that harm to litigants follows from failing to do so, and that a process by which such distinction could be discerned can alleviate that harm. When the distinction is made, some of the problems associated with expert testimony are alleviated.

Part One of this Note investigates the extent of the qualification problem. It exposes possible mistakes in the qualification of technical experts through a critical examination of trial and appellate opinions from federal courts and those state courts that utilize a Federal Rules counterpart. Part One demonstrates that errors are consistently the result of a misunderstanding of the roles of the various technical experts. After analyzing the problem, Part Two suggests an approach for assessing the qualifications of a technical expert and, more importantly, the appropriate scope of the expert's testimony Part Three examines the qualification problem from the perspective of the common law Part Four reveals the harm to litigants from failing to recognize the distinction between engineering and technically-skilled experts. Finally, Part Five concludes that resolution of the problem will follow from awareness by practitioners and not from appellate guidance. The Note also suggests new language for inclusion in the Rule's Advisory Notes to increase practitioners' awareness.

I. THE QUALIFICATION PROBLEM

Rule 702 states: “[A] witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise.”¹⁴ Further, the Advisory Committee's Note for Rule

11. The Federal Rules of Evidence require that expert testimony “assist the trier of fact” to be admissible. FED. R. EVID. 702.

The term “technological” is used to distinguish such evidence from the more general body of “technical” evidence. The term technical is used synonymously with technological in this Note. Technological evidence would include technology to which everyone has become accustomed (for example, automobiles, X-rays, fingerprints, computers), as well as “cutting edge” technology.

12. For the purposes of this Note, the term “engineer” is used broadly; for example, it would include applied scientists. However, there is an understanding that traditional academic training was completed by anyone designated as an engineer. Further, it is recognized that other professionals could qualify as experts on technological issues, but this Note focuses on engineering—arguably, the harbinger of technology.

13. A technically-skilled witness would include all competent technical witnesses other than engineers, including, for example, auto mechanics and technicians.

Much of the literature uses the terms “technology” and “science” synonymously. In fact, they are different. This Note confronts a legal problem precipitated by technology. It is understandably easy to mix the concepts; however, science and technology may pose different problems requiring different solutions. The Supreme Court recently noted this distinction. *See Daubert v. Merrell Dow Pharmaceuticals*, 113 S. Ct. 2786, 2795 n.8 (1993).

14. FED. R. EVID. 702.

702 asserts that litigants may draw expert witnesses from more than "scientific" or "technical" fields, and includes "skilled" witnesses—for example, bankers and auto mechanics.¹⁵ In making such a distinction, the Advisory Committee suggests, albeit vaguely, that judges could qualify different types of expert witnesses. The distinction between types of witnesses providing technical evidence lies in the basis of the expert knowledge and *its application*. An engineer gains expertise through participation in a traditional academic process with an emphasis on mathematics and science; a skilled witness—an auto mechanic, for example—gains knowledge through experience and less formal training.¹⁶

At first blush, the need to distinguish between engineers and other technically-skilled witnesses may seem trifling. One could argue that the line-drawing task is futile. John Wigmore argued that "the line, if any can be drawn, between these [types of technical qualifications] has no general legal significance. In truth no accurate line can be drawn. Each shades into the other imperceptibly"¹⁷ However, Wigmore also noted that "[o]n many points the nature of the subject is such that a scientific training is indispensable"¹⁸ The conclusion that scientific training can be indispensable begs the question: When is the technology sufficiently complex that testimony on such an issue must come from an engineer? Moreover, could seemingly technical issues create a false impression that only an engineer is competent to testify when, in fact, a technically-skilled witness would be equally competent?

Increasing complexity in technology will only exacerbate the situation. Likewise, a presumption favoring engineers—fortified by an aura of "high technology"—might persuade a judge to qualify an engineer who may actually be incompetent to testify. The converse is equally true; judges may disqualify engineers because of a lack of "practical" experience in areas of technology so common as to seem mundane.

A few examples will help define the distinction between engineering testimony and other technical testimony and present possible errors resulting from inappropriate qualification. In the state of Washington, a judge qualified an auto mechanic as a competent expert on the *direction of forces* cars experience in collisions. The expert based his opinion on an examination of accident photographs of the litigants' cars. The judge felt that the witness'

15. FED. R. EVID. 702 advisory committee's note.

16. Of course, engineers can gain practical experience and skilled witnesses can participate in academic exercises. Clearly, the distinction is not absolute, but by definition an automobile mechanic is not a mechanical engineering apprentice. The distinction between engineering and technically-skilled witnesses is defined through examination of the process by which the expert reaches a conclusion. See *infra* notes 38-42 and accompanying text.

17. 3 JOHN H. WIGMORE, EVIDENCE § 556 (Chadbourn rev. 1979); cf. JACK B. WEINSTEIN & MARGARET A. BERGER, WEINSTEIN'S EVIDENCE ¶ 702[04] (1982) (suggesting that a judge look for qualifications required by the case and that a judge ask whether "an expert who is qualified by practical experience rather than education may testify") (citation omitted).

18. WIGMORE, *supra* note 17, § 556.

thirty years of repair experience qualified him to make such a determination.¹⁹ The judge likely reasoned that mangled auto bodies reveal the direction of forces imparted on the colliding vehicles and that the witness had seen numerous damaged vehicles in a thirty-year career. Therefore, the experience of the auto mechanic justified his qualification as an expert.

Such logic, however, is dubious. First, it is questionable that the dynamic process of collapsing metal in an auto accident can be described by a single, static snapshot. Second, assuming that resultant damage reveals the directions of forces imparted, there is no link between the expert's repair experience and the conclusion made during the trial. The proponent of the mechanic's testimony should have proffered evidence sufficient to demonstrate how the mechanic could conclude that particular vehicle damage indicates a specific direction of impact. To the extent that the conclusion was just a gross approximation, the auto mechanic's testimony was no more authoritative than that which any lay juror could have made. Automotive repair training does not provide the basis for such a conclusion.²⁰

In a federal district court case, the plaintiff wanted to qualify a skilled expert witness in a personal injury case.²¹ A tractor-trailer owned and operated by the defendant skidded and lost control on ice; the accident injured the plaintiff. The plaintiff's expert was a United Parcel Service truck driver who had received in-house training about driving trucks on ice. The judge refused to qualify the witness as an expert. The judge reasoned that the witness was not an engineer and could not calculate the coefficient of friction.²² One need not be an engineer, however, or know how to calculate the coefficient of friction to know how to drive a truck on ice.²³ Furthermore, an engineer in this case would probably be easier to discredit.²⁴ Again, the judge's confusion likely stemmed from a distorted perception of engineering and the ambiguous construction of Rule 702.

These problems derive both from an ambiguous drafting of Rule 702 and from a misunderstanding by judges of what constitutes an engineer.²⁵ "[Rule 702] arguably mixes apples and oranges. On the one hand, experience, training and education seem methods of gaining the expert's unique ability to draw inferences. On the other hand, knowledge and skill are the end products of experience, training and education."²⁶ Moreover, the rule fails to express that the basis of qualification confines the scope of expert testimony. For example, expert testimony based upon education will not necessarily support

19. *McBroom v. Orner*, 395 P.2d 95, 96 (Wash. 1964).

20. See *infra* note 53 for a further discussion of this case.

21. *Hughes v. Hemingway Trans. Inc.*, 539 F. Supp. 130, 133 (E.D. Pa. 1982).

22. *Id.*

23. See *infra* note 51 for further discussion of this case.

24. An engineer has no more training in driving than a lay witness. While an engineer could conceivably calculate (after considerable time and expense) appropriate steering maneuvers to various wheel inputs, such a daunting task seems better handled by a skilled technical expert.

25. RONALD L. CARLSON ET AL., *EVIDENCE IN THE NINETIES: CASES, MATERIALS AND PROBLEMS FOR AN AGE OF SCIENCE AND STATUTES* 526 (3d ed. 1991).

26. *Id.*

inferences that correctly derive from experience. When the roles of experts are not clear—as is the case with technological experts—the potential for inappropriate qualification of witnesses is significant.

The distinction between witness types needs to operate in the realm between extremely complex technical evidence, where only an engineer could qualify as an expert, and less complex evidence, where a technically-skilled expert might readily qualify. In this gray area it becomes important not to confuse the roles of the different experts and thereby deny a party the opportunity to present expert testimony because of a misguided disqualification, or prejudice an opposing party by allowing an incompetent witness to testify. The qualification problem results from both inappropriately narrow and inappropriately broad views of the expert's role.²⁷

In the examples presented, justification for the qualification of the experts is obviously questionable. Cases, typically, do not illuminate the problem so brightly. Still, qualification problems readily can be found in both the federal courts²⁸ and in the state courts that adopt the Federal Rules of Evidence.²⁹

27. Consider, for example, *McBroom v. Orner*, 395 P.2d 95 (Wash. 1964), holding that an auto mechanic was qualified to testify as to the direction of forces in colliding vehicles, which demonstrates an unjustifiably broad view of the expert's role. The tractor-trailer case, *Hughes v. Hemmingway Trans., Inc.*, 539 F. Supp. 130, 133 (E.D. Pa. 1982), demonstrates both a narrow and broad view. The UPS driver's role as an expert was unduly limited, while the judge's perception of engineers was not supportable.

28. An engineer testifying about engineering science should usually be given broad discretion without regard to actual experience (of course, experience with the application of engineering science would go to the weight of the expert evidence). See *Exum v. General Elec. Co.*, 819 F.2d 1158 (D.C. Cir. 1987) (reversing a district court's "pinched" view of Rule 702 that required an engineer to have particular experience). If the engineering testimony is truly engineering science, then the engineer's title is of limited concern. *Head v. Lithonia Corp.*, 881 F.2d 941 (10th Cir. 1989) (allowing an electrical engineer to testify as to the safety of mechanical fasteners). The qualifications of a non-engineer testifying about engineering science, however, should be rigorously challenged. Cf. *Eastburn v. Ford Motor Co.*, 471 F.2d 21 (5th Cir. 1972) (sustaining the qualification of a witness with an MBA as an expert in machine design). Conversely, an engineer should not be given latitude to testify outside the scope of engineering science without sufficient particular experience. See *Johnson v. Inland Steel Co.*, 140 F.R.D. 367 (N.D. Ill. 1992) (qualifying an engineer to testify as to the likelihood of tripping in a stairwell).

The *Eastburn* and *Johnson* cases are examples of misguided qualification. Absent significant experience by a non-engineer, a judge generally should not qualify a non-engineer to testify about engineering science (machine design in the *Eastburn* case). Similarly, a judge should not qualify an engineer to testify in areas that require qualifications not obtainable by academic training, unless such an engineer can demonstrate particularized experience (safety in the *Johnson* case).

29. For example, one court allowed an engineer to express opinions without engaging in engineering analysis or having particular experience. *York v. National Continental Ins. Co.*, 463 N.W.2d 364 (Wis. Ct. App. 1990) (sustaining qualification of an industrial engineer as an expert in load shifting during tractor-trailer transport). Another court considered consultation with engineers as a relevant qualification. *Fink v. Lafayette Elec. Coop.*, No. 88-1648, 1990 LEXIS 45 (Wis. Ct. App. Jan. 23, 1990) (sustaining qualification of the party-plaintiff as an expert). To the extent that the court believed that engineering science was the subject of the opinion testimony, it should have only qualified an engineer as an expert.

As seen *supra* note 28, many areas of expert testimony appear to be engineering science. Often, for example, engineers are attributed with knowledge of safety. An engineer should not be qualified to testify on matters of safety without particular experience. See, e.g., *Maci v. State Farm Fire & Casualty Co.*, 314 N.W.2d 914 (Wis. Ct. App. 1981) (allowing an engineering expert to testify as to what constituted a safe walking surface). Similarly, courts sometimes presumptively forbid experts to qualify

Often, judges confused by roles inappropriately qualify technological experts. Therefore, practitioners and judges must understand the difference between engineering and other technical professions.³⁰

The skilled professional can solve problems within a realm narrowly defined by her experience. The engineer can solve a breadth of technical problems limited, theoretically, only by her creativity. However, the reach of science limits the depth of application by an engineer. Thus, an engineer providing insight into the *operation* of a device generally reaches an opinion based upon experience rather than by application of scientific theories.³¹ Consequently, a judge must take care to distinguish the engineer's role as a theorist and as an experiential technician.

In summary, the engineer can provide information broadly in a qualitative sense. Arguably arbitrary designations of engineering types (for example, mechanical, electrical, or civil) should not be generally dispositive of the qualification issue,³² nor should a lack of particular experience be decisive.³³ Any challenge in this regard would go to the weight of evidence. An engineer's practical understanding with particular technologies, however, will depend on either his experience with the technology or the compatibility of theory to answer such questions. The skilled technical witness will have an understanding of the practicalities of technology.³⁴ Of course, either witness type may cross over these definitional boundaries. Yet, judges and practitioners must take care to understand the distinction or recognize the consequences of qualifying an incompetent witness.

in areas of engineering science without realizing the qualitative contribution their experience might provide. *Oldakowski v. Heyen*, No. 87-0988, 1988 LEXIS 572 (Wis. Ct. App. May 19, 1988) (disallowing a medical doctor to testify to the protective qualities of a motorcycle helmet).

30. Engineering is the study of scientific principles—mathematics, physics, and engineering science—and their application to solve practical problems. Skilled technical professionals also solve practical problems. A first possible source of confusion of roles emanates from the common ground shared. However, though the application of skills is practical, the engineer's training is theoretical. In contrast, the skilled technical professional's training is practical.

Consider an example: both the engineer and technician are tasked with designing an automobile engine. The engineer will use principles of thermodynamics (the study of energy transport), heat transfer (the study of heat flow and temperature distribution), and machine design (the study of forces, stresses, and strains in machine members) to complete the design task. The technician will use her experience with automobile engines to complete the task. She will know from experience, for example, that increasing the piston diameter will increase power and operating temperature in a qualitative sense. An engineer can calculate those properties quantitatively.

31. For example, an engineer who can tune an engine can do so because of experience, not because she theorizes the proper approach.

32. The sciences applied in all branches of engineering are the same, only the applications differ. For example, it is a technique for mechanical engineers to convert mechanical components to their electrical analog for analysis.

33. See *supra* note 28.

34. It may be beneficial in some cases to view an engineer testifying on technical practicalities as in fact being a skilled technical witness who happens also to be an engineer.

II. SUGGESTED APPROACH TO QUALIFYING THE TECHNICAL EXPERT

The qualification of technological experts should proceed in three steps. First, recognition of the two different witness types is essential for appropriate qualification of the technological expert. Once the witness type has been identified, a useful qualification analysis can proceed. Next, the witness' background, education, experience, and curriculum vitae must be evaluated.³⁵ Finally, the proponent of the expert testimony must establish a "fit" or congruence between the expert's qualifications and testimony.³⁶ Often, the congruence between qualifications and testimony will be obvious. For example, the fit between the qualifications of a neurologist and testimony about head injuries is clear. Yet, could a neurologist testify about the protective qualities of a motorcycle helmet?³⁷ The congruence issue becomes important when the technological expert could be either an engineer or another technically-skilled witness.

Witnesses can be classified into two types based on the analytical process by which the expert reaches an opinion. The analytical process is either inductive or deductive. The inductive witness³⁸ will base her opinions upon her experience and other empirical data. From the collection of experiences, the inductive witness reaches various conclusions. Those conclusions form the

35. This step is traditionally deemed "qualifying an expert." However, under the proposed approach, the basis of qualification—knowledge, skill, experience, training, or education—will be influenced by the witness type.

36. The "fit" step is taken by analogy from *United States v. Downing*, 753 F.2d 1224 (3d Cir. 1985). In *Downing*, the court held that under certain circumstances an expert could testify on the reliability of eyewitness testimony. *Id.* at 1231-32. The court required that the factual conditions of the case must be sufficiently similar to the expert's theoretical parameters so that relevancy could be established. *Id.* at 1242. For example, if the eyewitness identification theory suggests that differences in race between the eyewitness and defendant impair the accuracy of the identification, then the proponent of the expert testimony must proffer such a racial difference. *Id.* Similarly, there must be congruence between the basis of the expert's qualification and the testimony to be given.

37. "[A neurologist] is not an expert as to the protective qualities of a motorcycle helmet. [The neurologist] has no expertise or special knowledge of motorcycle helmets or their capacity to withstand impact or prevent skull injury." *Oldakowski v. Heyen*, No. 87-0988, 1988 LEXIS 572, at *6 (Wis. Ct. App. May 19, 1988).

Yet, a neurologist may arguably be qualified to testify about the protective qualities of motorcycle helmets. Such an argument depends upon distinguishing between witness types. If the neurologist had witnessed—on sufficient occasions—the harm to motorcycle riders from failing to wear helmets, then the doctor might provide a qualitative opinion as to the protective qualities of helmets. However, since there would not be a fit between the neurologist's experiential basis of qualification and any opinion about forces on impact, the doctor could not offer a quantitative opinion. See *infra* note 52 and accompanying text.

38. The inductive witness might well be called an empirical witness or experiential witness.

rules and theories by which the expert reaches an opinion.³⁹ Technically-skilled witnesses are inductive witnesses.

By comparison, engineers typically are deductive witnesses. An engineer uses general theories of mathematics and science to reach case-specific opinions. Those theories used to reach an opinion do not depend upon the validity of the underlying empirical data.⁴⁰ In other words, the mathematical and scientific theories that form the basis of an engineering opinion are analytically formed. An engineer generally does not hypothesize a theory and then modify it to fit data collected in nature.⁴¹ The previous discussion, however, only applies to an engineer acting as a deductive witness; an engineer in other circumstances might act as an inductive witness.⁴²

After identifying the witness type, the task of reviewing relevant qualifications becomes easier. Education and demonstrated proficiency in analysis become the paramount concern regarding deductive witnesses, while experience is the primary concern regarding inductive witnesses. An engineer is trained in general principles; no particular application of mathematical or scientific theories is emphasized.⁴³ As such, engineers testifying as deductive witnesses would be competent experts in numerous situations, limited only by their ability to apply engineering principles. Judges and attorneys, however,

39. Many times the technological, inductive witness will personally form the theories upon which conclusions are reached. For example, the auto mechanic could form a theory that carbon deposits on spark plugs indicate a sticking choke after many observations of the problem. However, the inductive witness need not have made the observations personally. A psychologist uses empirically-based theories even though he may not have personally observed the underlying data. The status of the expert as an inductive witness does not change because the theories are learned through formal training. While the auto mechanic might learn of the cause of sticking chokes in a classroom, the theory is still formed inductively.

40. While the mathematical and scientific theories do not depend upon the validity of the underlying data, the case-specific data used in any calculation does present validity and reliability concerns.

41. For example, in developing differential calculus, Isaac Newton was able to establish that a force imparted to a body is equal to the body's mass times the rate of the body's acceleration.

42. For example, safety engineers likely will base opinions on empirical theories; the design of a protective guard follows from observation of the effectiveness of other guards. Thus, an engineer qualified as a safety expert should have particular experience with the safety concerns at issue. Not all engineers possess such expertise. In contrast, virtually any engineer could calculate, for example, the force a guard could withstand before failing.

43. Engineering education is traditionally divided along mechanical, electrical, chemical, or civil engineering lines. The underlying mathematical and scientific theories, however, are identical. In fact, mechanical systems have electrical analogs. The qualification issue is not whether there exists congruence between the engineer's title and the subject of the opinion rendered, but rather whether the engineer has sufficient proficiency in a particular application of his skills. *See* *Martin v. Fleissner GMBH*, 741 F.2d 61, 64 (4th Cir. 1984) (holding that a lack of direct experience with crimpers was an insufficient basis to reject the engineering expert's opinion because the testimony related to engineering design); *Dychalo v. Cooperloy Corp.*, 78 F.R.D. 146, 149 (E.D. Pa. 1978) (allowing a metallurgical engineer "to express an opinion that sounded in 'mechanical' engineering" because such an opinion used "basic principles common to all engineering study") (citation omitted); *cf.* *Nichols Constr. Corp. v. Cessna Aircraft Co.*, 808 F.2d 340, 354 (5th Cir. 1986) (finding harmless error in the district court's ruling that allowed an aeronautical engineer to testify about aircraft pressurization while also cautioning the jury that such testimony was "outside his 'specific area of responsibility'" (citation omitted).

should only attribute this latitude to an engineer testifying as a deductive witness.⁴⁴

The qualifications of an engineer acting as a deductive witness are easily measured by objective standards. Of principal concern is the educational background of the engineer including whether the engineer holds any advanced degrees. Publication of research papers in refereed journals provides an indication of proficiency.⁴⁵ Additionally, the engineer's proficiency using techniques needed to reach an opinion on a litigated issue can be measured by comparing the similarity of the techniques utilized during litigation with those techniques used by the engineer in his practice outside of litigation.

When an engineer or other technically-skilled witness acts as an inductive witness, experience⁴⁶ is the primary qualification issue. It is important not to attribute competency to an engineer testifying about matters outside of engineering science solely because of educational background.⁴⁷

Finally, there must be a fit between the expert's qualifications and the proposed testimony. If an engineer is acting as a deductive witness or testifying about engineering science, then the fit inherently follows and no further inquiry is required.⁴⁸ Yet, when an engineer or other technically-skilled witness acts as an inductive witness, the congruence issue becomes important.⁴⁹ The proponent of admission of the inductive witness' testimony must proffer foundational evidence that establishes the relevancy of the underlying empirical data forming the basis of opinion.⁵⁰ Relevancy is established by demonstrating sufficient similarity between the facts of a case and the data that form the inductive theory. Any dissimilarities between the facts and empirical data must be insignificant. Factors to be considered in

44. Failure to recognize this distinction can result in harm to the opposing party. See *infra* notes 74-82 and accompanying text.

45. These objective standards are particularly indicative of competency because the technical community, not the judiciary, makes the assessment of proficiency. Thus, such standards encompass one of the benefits of the *Frye* test for admissibility of novel scientific evidence. However, unlike the *Frye* standard, the qualification analysis will not necessarily limit the evidentiary benefits that advancing science has to offer.

46. Education is also an issue for qualification, especially for professional, inductive witnesses. See *supra* note 43. However, experience is likely the primary qualification criterion for the non-professional inductive witness testifying about technology.

47. An engineer testifying as an inductive witness must have the requisite experience to qualify. See *School Dist. No. 11 v. Sverdrup & Parcel*, 797 F.2d 651, 653 (8th Cir. 1986) (allowing a civil engineer to testify regarding the performance of an architect because of twenty years experience consulting architects); cf. *Hughes v. Hemmingway Transport Inc.*, 539 F. Supp. 130 (E.D. Pa. 1982) (holding that a court may disallow testimony of an expert witness if it finds requisite experience lacking).

48. A deductive witness testifies about the results of an analytical process. Her theories do not follow from empirical data; therefore, the theories are "valid" notwithstanding the underlying data. (Of course, her conclusion based upon the theories could be in error.) Thus the fit inherently follows.

49. Many times engineers will testify about ostensible engineering science. See *Maci v. State Farm Fire & Casualty Co.*, 314 N.W.2d 914 (Wis. Ct. App. 1981) (allowing an engineer to testify as an expert as to what constituted a safe walking surface); *Johnson v. Inland Steel Co.*, 140 F.R.D. 367 (N.D. Ill. 1992) (allowing an engineer to testify as an expert as to the likelihood of tripping in a stairwell). In these cases, the engineers were actually testifying as inductive witnesses; their experience with safe walking surfaces and stairwells should have been the primary qualification.

50. Cf. *United States v. Downing*, 753 F.2d 1224, 1242 (3d Cir. 1985). See *supra* note 36 for an explanation of the fit requirement in *Downing*.

deciding whether a fit exists are: 1) whether as a logical matter there exists sufficient similarity between the underlying empirical data that forms the theory and the facts of the litigated issue,⁵¹ 2) whether there are sufficient data points to justify a theory,⁵² and 3) whether as a logical matter the underlying empirical data or appropriate training in theories can support the conclusions to be made.⁵³ The judge can disqualify an inductive witness under Rule 104(a) if the correlation between the empirical data and induced theory is weak⁵⁴ or under Rule 403 if the testimony is a waste of time.⁵⁵

III. PERSPECTIVES FROM THE COMMON LAW

To better understand the rules-based analysis of the qualification issue, it may be useful to examine the common law approach to qualifying engineering and other technically-skilled experts. The practice and profession of engineering as it is known today was born in this country contemporaneously with the Industrial Revolution.⁵⁶ During this period, while expert witness testimony was generally an established litigator's tool, the engineering expert faced uncertain prospects. In some cases, judges disallowed engineering testimony about subjects that one with modern hindsight would clearly deem

51. In the *Hughes* case, the witness was not qualified as an expert in tractor-trailer skid control—because he lacked engineering training—despite being trained in skid-control by his employer. *Hughes v. Hemingway Trans.*, 539 F. Supp. 130, 133 (E.D. Pa. 1982). The witness' lack of engineering training is irrelevant concerning the qualification of an inductive witness. The proper focus should have been placed on the fit between the witness' driving experience and the driving conditions that existed in the case. If the witness had driven similar trucks under similar icy and skidding conditions, then he arguably could have been qualified as an inductive witness.

52. In Wisconsin, a neurologist cannot qualify as an expert on the protective qualities of motorcycle helmets or hard hats. *Oldakowski v. Heyen*, 428 N.W.2d 644, 647 (Wis. Ct. App. 1988) (“[A neurologist] has no expertise or special knowledge of motorcycle helmets or their capacity to withstand impact or prevent skull injury.”). To the extent that this decision held that a neurologist cannot qualify as a deductive expert—one capable of calculating the energy attenuation properties of helmets—the holding is consistent with this Note. Yet, given sufficient experience by a neurologist who has observed the effects of both wearing and not wearing protective head gear, the neurologist could qualify as an inductive witness. The issue becomes whether the neurologist has observed sufficient data points to form a qualitative theory of helmet protection. Arguably, such information should meet the “assist-the-trier-of-fact” test.

53. In Washington, a witness qualified, based on 30 years experience repairing automobiles, as an expert on the direction of forces exerted by vehicles in a collision. The expert testified about the direction of forces in colliding vehicles after observing the damage to the vehicles. *McBroom v. Orner*, 395 P.2d 95, 96 (Wash. 1964). To qualify as an inductive witness, there must be some correlation between the data observed and conclusions made. The expert in *McBroom* would need to know—through the course of his thirty years experience—for each vehicle repaired, the direction of forces exerted (perhaps his customers could have told him the directions they were pushed during collisions) in conjunction with the resultant damage to the vehicle. Only when there is such a complete set of data could the auto mechanic have been qualified as an inductive witness. If a data point necessary to induce a theory is missing from the underlying empirical data, then the “expert” using such data is making a conclusion that any lay juror could make and does not assist the trier of fact.

54. See WEINSTEIN & BERGER, *supra* note 17, ¶ 702[04], at 702-45.

55. 56 F.R.D. 183, 218 advisory committee's note.

56. See CARROLL W. PURSELL, *TECHNOLOGY IN AMERICA: A HISTORY OF INDIVIDUALS AND IDEAS 69-70* (1981); TERRY S. REYNOLDS, *THE ENGINEER IN AMERICA: A HISTORICAL ANTHOLOGY FROM TECHNOLOGY AND CULTURE 7-26* (1991).

an appropriate engineering subject.⁵⁷ Other courts recognized the import of an engineering education.⁵⁸ Perhaps the disparate views can be attributed to the youthful position engineering academia maintained relative to scientific study—an area traditionally accorded the need for expert testimony⁵⁹ Interestingly, engineers during this period were trained either through an academic process similar to its modern counterpart or were trained through apprenticeship and on-the-job training—akin to the skilled technical witness.⁶⁰

Nineteenth century common law required that expert testimony be given only on matters in which lay jurors could not form a conclusion from assessing the facts. Namely, only conclusions that could not be verified by the trier of fact were allowed.⁶¹ Two factors operated to prevent engineers from giving testimony. First, the expert must have had “special practical acquaintance” with the proposed line of inquiry.⁶² Such an approach barred testimony from engineers without practical experience comparable to the issues in dispute.⁶³ Second, general knowledge of an issue in dispute was sufficient. “[The expert] need not be exhaustively acquainted with the differentia of the specific specialty under consideration.”⁶⁴ Many times—in areas that are today considered engineering—early judges accepted testimony from non-engineers⁶⁵ or deemed expert testimony inappropriate because it

57. In *Clark v. Detroit Locomotive Works*, 32 Mich. 348 (1875), the court held that an engineer was not competent to opine on the cause of bearing heating and binding because the cause of the defects presented sub judice was outside the scope of opinion evidence. “It is not a question of science or mechanics, and is not peculiar to shipping. Precisely similar questions might arise in the use of any implement or machinery on land or water.” *Id.* at 350. On other occasions, engineers were deemed incompetent because they did not have particularized experience. See *Benedict v. Fond du Lac*, 44 Wis. 495, 496-97 (1878) (noting the trial court reliance on a civil engineer’s lack of actual experience in highway construction).

58. An engineering education was sufficient to allow a witness to qualify as an expert; practical experience was not required. *Central R.R. v. Mitchell*, 63 Ga. 173 (1879); cf. *Indianapolis v. Scott*, 72 Ind. 196, 203 (Ind. 1880) (finding a civil engineer competent to opine on the soundness of timbers in bridges, but also noting that the witness “had handled woods since he was a boy”) (citation omitted).

59. “The non-expert gives the results of a process of reasoning familiar to every-day life; the expert gives the results of a process of reasoning which can be mastered only by special scientists.” FRANCIS WHARTON, 1 COMMENTARY ON THE LAW OF EVIDENCE IN CIVIL ISSUES 394 (3d ed. 1988).

60. See REYNOLDS, *supra* note 56, at 13-23. However, even the engineering institutions disagreed on the proper approach to engineering education, diverging along the theoretical-practical line. Schools such as Stevens Institute of Technology, Sibley College at Cornell, and Massachusetts Institute of Technology emphasized higher mathematics, theoretical science, and original research (consistent with the French and German tradition). Other schools, such as the Rose Polytechnic Institute, stressed practical shop experience (consistent with the British approach). Graduates from the latter group were able to work as shop foremen and machinists. *Id.* at 124.

61. *Schmeder v. Barney*, 113 U.S. 645 (1885); *Milwaukee v. Kellogg*, 94 U.S. 469 (1876); WHARTON, *supra* note 59, at 395.

62. WHARTON, *supra* note 59, at 401.

63. Cf. *supra* note 31 and accompanying text.

64. WHARTON, *supra* note 59, at 401.

65. See, e.g., *Bemis v. Central Vermont R.R.*, 58 Vt. 636, 641 (1886) (finding a carpenter competent to testify as to the “strength of such [hoisting equipment], and with the strain upon its different parts when used to its capacity”); *Brabbits v. Chicago & Northwestern Ry.*, 38 Wis. 289 (1875) (finding a mechanic competent to testify on the effects of a leaking throttle valve); *Murphy v. New York Cent. R.R.*, 66 Barb. 125 (N.Y. Ch. 1867) (noting that a mechanic could testify as to the workings of a railroad car on a curve).

was within the realm of understanding of a lay person.⁶⁶ This observation is not to suggest that the non-engineers were not competent to testify in all the cited cases. However, it is clear that in its infancy, engineering was not accorded its due depth or breadth of application. Unfortunately, many of the problems exhibited in the nineteenth century continue today

IV. ANALYSIS OF THE HARM FROM INAPPROPRIATE QUALIFICATION

In a trial, harm to litigants results either from improper qualification of an incompetent expert or failure to qualify a competent expert.⁶⁷ The first problem provides a vehicle for introduction of unreliable proof, while the latter problem denies a litigant the opportunity to present credible evidence. Again, the inductive-deductive analysis prevents improper qualification of experts and mitigates the harm to litigants. Moreover, the inductive-deductive dichotomy, when properly applied, alleviates some of the traditionally recognized complaints about expert witnesses.

First, any inappropriate expectation by the trier of fact of expert testimony, generally, and engineering evidence, specifically, can be put into proper perspective by limiting expert testimony to areas for which the expert is actually qualified. The inductive-deductive distinction will constrain testimony within appropriate boundaries so that a jury will not overvalue specious testimony. Second, questionable and irrelevant expert testimony can be eliminated to the extent that such testimony inappropriately crosses the inductive-deductive line. Finally, given that it is more likely for a deductive witness to use extra record evidence, a party opponent can use the distinction between witness types to highlight the fact that the inductive witness' opinion flows from evidence within the record.

Juries may overvalue the testimony of engineers. Overvalued expert testimony is perhaps an unavoidable consequence of the need for experts. Still, many courts have recognized the potential that jurors will place undue emphasis on scientific testimony.⁶⁸ Some research has substantiated these judicial speculations.⁶⁹ Judges, too, may be suspect of overvaluing scientific

66. See, e.g., *Enright v. San Francisco & San Jose R.R.*, 33 Cal. 230, 236-37 (1867) (holding that the sufficiency of a fence to withstand the forces imparted by domestic animals was not an issue "of science nor of peculiar or educated skill" and should be determined by the jury).

67. See *supra* notes 19-24 and accompanying text.

68. *United States v. Addison*, 498 F.2d 741, 744 (D.C. Cir. 1974) ("[S]cientific proof may in some instances assume a posture of mythic infallibility in the eyes of a jury of laymen.") (citation omitted); *United States v. Amaral*, 488 F.2d 1148, 1152 (9th Cir. 1973) ("Scientific testimony particularly courts [a danger of undue prejudice] because of its aura of special reliability and trustworthiness.") (citation omitted); *People v. Collins*, 438 P.2d 33, 33 (Cal. 1968) ("Mathematics, a veritable sorcerer in our computerized society, while assisting the trier of fact in the search for truth, must not cast a spell over him.") (citation omitted); see also *Reed v. State*, 391 A.2d 364, 370 (Md. 1978).

69. "It is well documented by numerous laboratory studies that, other things being equal, [the expert witness] attributed to have the greater status or credentials is usually the more persuasive or influential." Steven C. Bank & Norman G. Poythress, Jr., *The Elements of Persuasion in Expert Testimony*, 10 J. PSYCHIATRY & L. 173, 178 (1982). The study made comparisons between the credibility of experts, not experts and lay witnesses. *Id.*

testimony⁷⁰ Yet, in the context of the inductive-deductive dichotomy, overvalued *irrelevant* testimony can be avoided. If an engineering witness lacking sufficient experience to qualify as an inductive witness⁷¹ cloaks otherwise incompetent testimony in engineering-science garb, then a jury potentially could overvalue unreliable testimony. Adequate review of an expert's credentials including the inductive-deductive distinction would prevent admission of unfounded theories disguised as engineering science. The converse is equally true. The inductive-deductive distinction can be used to prevent an inductive witness from offering engineering science testimony.

Moreover, once judges and practitioners identify the witness types, the distinction clarifies the appropriate scope of the witness' expertise. When the true role of experts is clear, the trier-of-fact is in a better position to attach suitable weight to the expert's opinion.

Notwithstanding the prior suggestion, a jury may have no problem attributing an appropriate weight to expert testimony⁷² But assuming that to be true, problems still remain. First, there may be a presumption in technical cases that the experts must have technical backgrounds.⁷³ Such a presumption would disfavor the inductive witness and thus promote the use of engineering testimony with its concomitant concerns—the reliance on extra-record evidence and the potential for introduction of hearsay.

In bolstering the credibility of an expert witness, attorneys will select, as circumstances allow, witnesses with significant trial experience.⁷⁴ Therefore, if available, attorneys might select "professional" experts—whether inductive or deductive—because of their trial experience and demonstrated track record. Absent such a resource, attorneys must select experts from the technical community rather than classified advertisements. As such, credibility concerns

70. In a poll of judges and lawyers, 70% of those questioned thought juries gave scientific evidence more weight and 75% thought judges found scientific evidence more credible. SAKS & VAN DUIZEND, *supra* note 7, at 5.

71. See *supra* notes 38-39 and accompanying text.

72. "Jurors not only trust their own perception and memory; they tend to trust the perception and memory of other lay persons as well." Edward J. Imwinkelried, *The Standard for Admitting Scientific Evidence: A Critique from the Perspective of Juror Psychology*, 28 VILL. L. REV. 554, 570 (1982-83); see also Neil Vidmar & Regina A. Schuller, *Juries and Expert Evidence: Social Framework Testimony*, 52 LAW & CONTEMP. PROBS. 133, 161 (1989) (suggesting that jurors do not appear to suspend their own judgment in deference to the expert). But see James M. Doyle, *Applying Lawyers' Expertise to Scientific Experts: Some Thoughts About Trial Court Analysis of the Prejudicial Effects of Admitting and Excluding Expert Scientific Testimony*, 25 WM. & MARY L. REV. 619, 626 (1984) (suggesting that jurors are more likely to defer to witnesses with expertise for which the jurors have no everyday life equivalent).

73. See Imwinkelried, *supra* note 72, at 559. While largely anecdotal, Imwinkelried notes that some prosecutors believe that jurors expect scientific evidence of guilt. *Id.* It is not unreasonable to infer a similar expectation in civil cases dealing with complex technical issues. The issue is whether the inductive witness without educational credentials would fulfill that expectation. If a jury responds more favorably to scientific evidence, then it is not unreasonable to believe they will respond more favorably to a scientist delivering such testimony. Moreover, the attorneys selecting the experts may fuel the expectation by preferring engineers.

74. Confidence and charisma increases credibility. Bank & Poythress, *supra* note 69, at 180. Arguably, experience in a trial setting will bring additional confidence. The inductive witness with particularized expertise will have less opportunity to act as an expert than an engineer with broader expertise.

may dictate that engineering experts testify. If the previous assumption—that in technical cases juries expect scientific evidence—is valid, then delivery of scientific evidence by a scientist rides on the jury's expectations. Consequently, trial tactics rather than reliability become the impetus for the selection of experts.⁷⁵ By recognizing the inductive-deductive distinction, however, a party-opponent might successfully argue for disqualification of the engineering expert who lacks sufficient experience to form inductive theories.

Moreover, the inductive-deductive distinction sheds light on the credibility of "professional" inductive witnesses. The inductive expert's strength as a witness depends on her experience. A "professional" inductive witness' experience predominately consists of courtroom testimony rather than application of her craft. When a practitioner properly identifies an expert as inductive, the credibility of the "professional" inductive witness can be challenged by noting her lack of real world experience.

Also, the inductive-deductive dichotomy reveals the source of unreliable evidence. Judges and practitioners may inappropriately use the educational background of an engineer to support finding sufficient qualifications to act as an inductive witness. When the underlying empirical data is incomplete or questionable assumptions supplement the data, an educational background cannot fill the gaps.⁷⁶ Under those conditions when the connection between the underlying empirical data and the expert's opinion is tenuous, the jury receives unreliable testimony. Judges should exclude such testimony.⁷⁷

Furthermore, the engineering expert improperly qualified as an inductive witness introduces potentially less reliable evidence from a hearsay perspective. While Rule 703 allows otherwise inadmissible evidence "of a type reasonably relied upon by experts in the particular field" to form the basis of an expert's opinion,⁷⁸ engineering testimony improperly classified as experiential testimony will possess fewer of the traditional indicia of reliability.⁷⁹ Consider a wrongful death action where the plaintiff's expert

75. Moreover, such tactics may influence selection of the less reliable witness. See *infra* notes 83-85 and accompanying text.

76. Lee W. Miller, *Cross-Examination of Expert Witnesses: Dispelling the Aura of Reliability*, 42 U. MIAMI L. REV. 1073, 1083 (1988); see also Carlson, *Modern Expert Testimony*, *supra* note 3, at 588 (noting that engineering testimony was excluded because facts contrary to undisputed evidence and unrealistic assumptions cannot be reasonably relied on by experts).

77. See *United States v. Fosher*, 590 F.2d 381, 383 (1st Cir. 1979). Besides relevancy, the *Fosher* court also listed failure to assist the trier of fact, confusion of the issues, waste of time, failure to base testimony on generally accepted scientific principles, and appropriate cross-examination as reasons for excluding expert testimony. *Id.* at 382-84. The court did not indicate whether the reasons would operate independently to exclude expert testimony.

"If the underlying data are so lacking in probative force and reliability that no reasonable expert could base an opinion on them, an opinion which rests entirely upon them must be excluded." Carlson, *Modern Expert Testimony*, *supra* note 3, at 583 (quoting *In re Agent Orange Prod. Liability Litigation*, 611 F. Supp. 1223 (E.D.N.Y. 1985)).

78. FED. R. EVID. 703.

79. Indicators of reliability include perception, memory, narration, and sincerity. MCCORMICK ON EVIDENCE § 245 (John W. Strong ed., 4th ed. 1992). Additionally, an opportunity for cross-examination provides "the greatest legal engine ever invented for the discovery of truth." *Id.*

was an industrial engineer.⁸⁰ The decedent dock-worker was found crushed under bales that were transported in the defendant's tractor-trailer; there were no witnesses to the accident.⁸¹ The expert concluded that the bales had shifted during transport and that the resulting stress caused the bales to fall forward and crush the decedent when he attempted to unload the bales.⁸²

The industrial engineering expert in that case testified as an inductive witness;⁸³ he based his opinion upon discussions with witnesses to the conditions of the accident.⁸⁴ Such conversations, however, are in some degree subject to all the problems of hearsay including perception, memory, narration, and sincerity.⁸⁵ A technically-skilled witness, however, with experience in loading and transporting trailers could testify on the likelihood of load shifting. Compared to an engineer acting as an inductive witness, the technically-skilled witness does not rely so heavily upon the sincerity of hearsay to conclude that a particular loading scheme is more or less likely to shift.

The inductive witness usually forms empirical theories from many data points collected from years of experience. Thus, the true inductive witness can form an opinion on the ultimate issue (in the present example, whether the loading scheme was subject to toppling) based on personal experience, not questionable hearsay. The inductive witness' experience becomes part of the trial record and is subject to analysis by the trier-of-fact. As such, the jury can independently assess the validity of the inductive theories. On the other hand, the trier-of-fact cannot effectively scrutinize the opinions of an engineer marginally acting as an inductive witness; the jury is unable to conduct a viable, independent assessment of the engineer's theories. A failure to recognize the proper scope of engineering testimony from a reliability perspective can result in qualification of the less favorable witness.

Furthermore, an engineer acting as either an inductive or deductive witness is apt to base an opinion on extra-record evidence.⁸⁶ In contrast, the

80. *York v. National Continental Ins. Co.*, 463 N.W.2d 364 (Wis. Ct. App. 1990).

81. *Id.* at 366.

82. *Id.* at 367.

83. The engineer could have testified as a deductive witness, modeling the configuration of the bales to determine if transport could have caused them to topple. However, the opinion implies that the expert's conclusion was based only upon an examination of the physical conditions of the accident. *Id.*

84. The engineering expert's opinion was based upon disputed conditions. First, the defendant argued that the decedent was improperly unloading by hand and that such manual unloading caused the bales to shift. The expert opined that the decedent was using a forklift. That conclusion was based upon observations by witnesses of the accident scene. *Id.* at 366. Second, the condition of the trailer floor was in dispute. The expert concluded that the trailer floor was wet and that the wetness prevented the decedent from avoiding the falling bales. *Id.* Again, the expert's opinion was not based upon personal observations.

85. The perception of the on-scene witnesses may go untested. Further, the engineer's investigation is subject to the ability of the on-scene witnesses to remember the event. Problems with narration could occur. However, the most significant concern is the sincerity of the witnesses. Fear of personal liability could motivate the witnesses to distort their observations. At the time of the engineer's investigation, the witnesses are not subject to cross-examination.

86. Carlson notes that:

Courts have not always appreciated the fine but important distinction between allowing an extra-record report to form a basis for courtroom opinion and permitting the whole of the

technically-skilled witness acting as an inductive witness will base conclusions on evidence contained within the record.⁸⁷ The use of an inductive witness provides the jury the opportunity to independently validate the inductive theories because all elements of such theories are contained within the record.

The deductive witness' testimony, too, may include unreliable evidence. Without appropriate judicial scrutiny, the engineer could introduce hearsay or other inadmissible evidence into the record. Such hearsay can be particularly questionable when an engineer acts as an inductive witness.⁸⁸ Commentators have grappled with the problems associated with the admissibility of the bases of expert opinions.⁸⁹ Therefore, in those jurisdictions taking a passive approach to controlling the bases of expert testimony, it may be beneficial for opponents of engineering experts to aggressively attack the qualifications of engineering experts acting as inductive witnesses.

report to come into evidence. [M]ost experts will not rely exclusively on reports of others

With technical subjects, such as engineering, a highly qualified expert may develop his opinions from primary records generated exclusively by other professionals. While some of these underlying records will have been offered and received into evidence by the time the expert testifies, others will not

Carlson, *Modern Expert Testimony*, *supra* note 3, at 584-85.

Frequently, an engineer will rely on computer software to assist in the analysis of problems. Generally, computer generated reports are admissible under the business records exception, FED. R. EVID. 803(6), or the public records exception, FED. R. EVID. 803(8). *United States v. Smith*, 973 F.2d 603, 605 (8th Cir. 1992); *United States v. Moore*, 923 F.2d 910, 914 (1st Cir. 1991). The computer generated output in these cases is merely a compilation of data previously imputed. The output of engineering software, however, results from the algorithms and assumptions of the programmer. If an engineer uses commercial software, those algorithms and assumptions may be taken for granted or unknown. The output of the program is arguably implied hearsay. Also, it would not be independently admissible under the business or public records exceptions.

The admissibility of the output of computer simulations will depend upon whether the underlying assumptions are "reasonably relied upon by experts in the particular field." FED. R. EVID. 703; *see, e.g., Starr v. Campos*, 655 P.2d 794 (Ariz. Ct. App. 1982). It is questionable, however, whether the experts relying upon the computer simulation will even know what the underlying assumptions are.

87. Because the inductive theories of the empirical witness will be based upon past experiences, the whole of the witness' experience will probably appear in the record as summary.

Yet, inductive testimony presents its own concerns. Opponents of expert inductive testimony, however, can challenge the link between experience and theory during voir dire or cross-examination. Once the inductive witness is qualified, his testimony is only relevant when the predicate facts of the case are introduced into evidence.

88. *See supra* notes 75-85 and accompanying text.

89. *See Carlson, Hearsay Conduits, supra* note 2, at 872 ("Courts should actively police the bases of modern expert testimony. [T]he solution is for the trial judge, before testimony, to assess the trustworthiness of the material which the expert relied upon.") (citation omitted); *see also* Carlson, *Modern Expert Testimony, supra* note 3; *cf. Faigman, supra* note 2 (noting an inconsistency in having a restrictive standard for admission of underlying data but a liberal standard for opinion testimony generally); Paul R. Rice, *Inadmissible Evidence as a Basis for Expert Opinion Testimony: A Response to Professor Carlson*, 40 VAND. L. REV. 583 (1987) (finding it illogical to admit the expert's opinion as substantive evidence but not the underlying data).

V RESOLUTION OF THE QUALIFICATION PROBLEM

Appellate courts are not likely to resolve the problems associated with the qualification of technological experts. First, qualification of an expert is within the broad discretion of the trial judge;⁹⁰ appellate courts will not disturb such discretion unless the ruling is manifestly erroneous.⁹¹ Moreover, appellate courts typically refrain from commenting extensively on the qualification of experts.⁹² Even when appellate courts provide guidance, reversals for abuse of discretion are rare.⁹³ The "bewildering thicket of overlapping legal principles" involved in expert testimony limits significant appellate opinion to extreme cases.⁹⁴ These conditions are not the best impetus for change by appellate courts. Trial judges and practitioners must recognize the subtle problem described in this Note.

Yet, one study revealed that a majority of federal and state judges responding to a survey found few or no problems with the qualification of experts.⁹⁵ In cases involving technical issues, sixty-five percent of the federal judges surveyed and fifty-seven percent of the state judges surveyed opposed special rules for the qualification of expert witnesses.⁹⁶ If those statistics suggest that trial judges are unaware of or do not know that the technological-expert qualification problem exists, then there is a greater burden on practitioners to be conscious of the problem and raise it when it occurs.

Redrafting Rule 702 or including clarification and guidance in the Advisory Note to the Rule would address the qualification problem. The Standing Committee on Rules of Practice and Procedure of the Judicial Conference of the United States ("Standing Committee") submitted for public comment a modified version of the Civil Rules Advisory Committee's ("Advisory

90. See, e.g., *Salem v. United States Lines Co.*, 370 U.S. 31, 35 (1962); *Fernandez v. Chios Shipping Co.*, 542 F.2d 145, 153 (2d Cir. 1976).

91. *Fernandez*, 542 F.2d at 153.

92. Doyle, *supra* note 72, at 629.

93. MCCORMICK ON EVIDENCE, *supra* note 79, § 13.

94. Not all commentators, however, would agree that procedural complexities limit appellate opinion. Cf. Jack B. Weinstein, *Rule 702 of the Federal Rules of Evidence Is Sound; It Should Not Be Amended*, 138 F.R.D. 631, 641 (1991) ("It should be pointed out that in the thousands of cases before me in the past twenty-five years, in only three that I can recall was exclusion of an expert's testimony warranted. [P]erhaps this is partly due to our skilled federal bar and to the fact that federal judges strongly discourage the digression from our task of searching for the truth to play courtroom games.")

95. *Judges' Opinions on Procedural Issues: A Survey of State and Federal Trial Judges Who Spend at Least Half Their Time on General Civil Cases*, 69 B.U. L. REV. 731, 738 (1989) (indicating that 31% of federal judges and 35% of state judges had few problems with the qualification of experts; 25% of federal judges and 23% of state judges had no problems).

96. *Id.* at 741.

Committee") proposed revisions to Rule 702.⁹⁷ The clarification and guidance provided in the Advisory Note is, however, the optimal approach.

Rule 702 as originally proposed by the Advisory Committee requires that an expert be qualified "by knowledge, skill, experience, training, or education to provide such assistance" as needed by a jury to understand the evidence.⁹⁸ Such a requirement is too restrictive; it would operate to narrow the appropriate scope of expert testimony.⁹⁹ The requirement might limit questionable testimony from engineers acting as inductive witnesses,¹⁰⁰ but it might also prevent skilled witnesses from offering their insight into litigated issues.¹⁰¹

The proposed Rule 702 as amended by the Standing Committee changes the language so that an expert must be qualified "to provide such testimony"¹⁰² To the extent that this language mirrors the Advisory Committee language, it is similarly too restrictive. To the extent that the language is "unclear in its effect," it goes no further than the present Rule to solve the qualification problem.¹⁰³ In policing the bases of expert testimony, the proposed rules

97. Becker & Orenstein, *supra* note 7, at 861-62. When the amendments to Rule 702 were originally proposed, the Standing Committee with the assistance of the Advisory Committee proposed changes to the Federal Rules of Evidence. At that time, no independent committee on the Federal Rules of Evidence existed. *Id.* at 860. The proposed Rule 702 is now before the new Advisory Committee on the Federal Rules of Evidence. See 147 F.R.D. 275, 282 (1993).

The Advisory Committee originally proposed revising Rule 702 as follows:

If the court finds (1) that reliable scientific, technical, or other specialized information will substantially assist the trier of fact to understand the evidence or to determine a fact in issue; and (2) that a witness is qualified as an expert by knowledge, skill, experience, training, or education to provide such assistance, it may permit the witness to testify thereto in the form of an opinion or otherwise. Except with leave of the court for good cause shown, the witness shall not testify on direct examination in any civil action to any opinion or inference or reason or basis therefor, that has not been seasonably disclosed as required under the proposed amendments to Rules 26(a)(2) and 26(e)(1) of the Federal Rules of Civil Procedure.

Weinstein, *supra* note 94, at 636.

The proposal as amended by the Standing Committee reads as follows:

Testimony providing scientific, technical, or other specialized information, in the form of an opinion or otherwise, may be permitted only if (1) the information is reasonably reliable and will substantially assist the trier of fact to understand the evidence or to determine a fact in issue and (2) the witness is qualified as an expert by knowledge, skill, experience, training, or education to provide such testimony. Except with leave of the court for good cause shown, the witness shall not testify on direct examination in any civil action to any opinion or inference, or reason or basis therefor, that has not been seasonably disclosed as required under the proposed amendments to Rules 26(a)(2) and 26(e)(1) of the Federal Rules of Civil Procedure.

137 F.R.D. 53, 156 (1991).

98. See text of proposal, *supra* note 97.

99. "The words 'such assistance' means that the judge must find that the witness' expertise is directed to providing the substantial assistance in the expert's particular field of expertise. The testimony of a general medical practitioner would arguably not suffice if a medical specialist usually dealt with the matter in question." Weinstein, *supra* note 94, at 637.

100. See the discussion of problems associated with engineers acting as inductive witnesses without sufficient experience to form empirical theories, *supra* notes 75-87.

101. See the example, *supra* note 52, of the neurologist and expert testimony on the protective qualities of helmets. The proposed language would restrict the doctor's testimony to neurology. Yet, the example demonstrated the qualitative insight that neurologists might provide on the protective qualities of helmets.

102. 137 F.R.D. 53, 156 (1991).

103. See Weinstein, *supra* note 94, at 639.

require that scientific evidence be "reasonably reliable" and "substantially assist the trier of fact."¹⁰⁴ While the rules do not incorporate the *Frye* standard,¹⁰⁵ they do attempt to weed out marginally helpful and scientifically questionable expert testimony.¹⁰⁶ The amendments, however, do not alter the drafting of the bases of qualification; they again list "knowledge, skill, experience, training, or education" without an effective limiting clause.¹⁰⁷

Moreover, revisions to Rule 702 are not likely the best solution to the qualification problem. The proposed revisions place an increased burden on the judiciary to decide the appropriate qualifications of experts.¹⁰⁸ Judges are not in the best position to learn the subtleties associated with the qualification of technological experts. A better solution is one that focuses attention on the qualification problem and allows the adversarial system to act accordingly. With an understanding of the qualification problem, party-opponents can effectively challenge inappropriate qualifications through voir dire. "[T]he Advisory Committee [should] make changes in Notes accompanying Rules or provide continuing commentaries rather than following the present trend of increased complexity and detail in the rules whenever the bench or bar is seen as threatening to go astray in a procedural area."¹⁰⁹ The Advisory Note to Rule 702 should generate the needed awareness of the problem.

The Advisory Note could include the following language:

While Rule 702 provides several bases for qualification of experts, one basis will not necessarily provide the expertise another basis might provide. The manner of qualification should logically justify the scope of the expert's testimony. Technological experts are particularly prone to inappropriate qualification when the methods of qualification are not properly distinguished.

Many of the examples provided by this Note could be included with the comments to the Advisory Note to illustrate the problem. The caveat would provide a warning to the bench and bar of the qualification problem and caution that a fit must exist between an expert's qualifications and testimony. As demonstrated in this Note, the problem can be acute when technological experts are used.

104. See *supra* note 97.

105. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923); see *Daubert v. Merrell Dow Pharmaceuticals*, 113 S. Ct. 2786 (1993) (holding that the *Frye* test was superseded by the enactment of FED. R. OF EVID. 702).

106. See 137 F.R.D. at 156, advisory committee notes.

107. *Id.*

108. "The Rule 702 proposed amendments would make use of experts more difficult. They would shift to the judge substantial power to exclude or limit expert testimony." Weinstein, *supra* note 94, at 634.

109. *Id.*

VI. CONCLUSION

Clearly, there is a role in the courtroom for both the engineering expert and the technically-skilled expert. Problems arise, however, when judges and practitioners do not recognize a distinction between the witness types. Failure to make the inductive-deductive distinction injects unreliable and irrelevant evidence into the trial. The inductive-deductive distinction is easily applied and can alleviate any confusion regarding the appropriate roles of the various technological experts. When the roles of the witness types are clear, a judge can suitably qualify technological experts and constrain the expert's testimony to areas actually within the expert's knowledge. Further, the inductive-deductive dichotomy highlights and, in some cases, mitigates the problems inherent in expert testimony.