11-1974

The Technological Expert in Products Liability Litigation

Aaron Twerski
Brooklyn Law School, aaron.twerski@brooklaw.edu

William A. Donaher

Henry R. Piehler

Alvin S. Weinstein

Recommended Citation
52 Tex. L. Rev. 1303 (1974)

The Technological Expert in Products Liability Litigation†

William A. Donaher,* Henry R. Piehler,**
Aaron D. Twerski,*** and Alvin S. Weinstein****

The technical expert performs a vital role in negligence actions. He is uniquely qualified to extract from complex facts the opinions and conclusions that will aid the jury in its determinations. In strict products liability litigation the role of the technologist is pivotal. Beyond the traditional function of distilling technological data, the technical expert in products liability actions bears an expanded responsibility arising from the necessity of addressing questions of major societal significance.[1]

I. Strict Liability and the Unreasonably Dangerous Product

In strict products liability the fundamental issue centers on the efficacy of the product in the environment of its use.[2] Yet the case law discloses much confusion concerning the manner in which the strict liability standard should be formulated in order to reflect this concept. The earliest expression of this idea is found in § 402A of the *Restatement (Second) of Torts,* which predicates liability upon a finding that

† This article originated in an ongoing research project entitled "Product Liability: An Interaction of Law and Technology." The entire study was financed by a grant, GI-34857, from the National Science Foundation within its program of Research Applied to National Needs (RANN).

* Professor of Law, Duquesne University. A.B. 1949, Catholic University of America; LL.B. 1952, Harvard University.

** Associate Professor of Metallurgy, Materials Science, and Public Affairs, Carnegie-Mellon University. S.B. 1960, S.M. 1962, Sc. D. 1967, Massachusetts Institute of Technology.

*** Associate Dean and Professor of Law, Hofstra University. A.B. 1962, Beth Medrash Elyon Research Institute; B.S. 1970, University of Wisconsin; J.D. 1965, Marquette University.

**** Professor of Mechanical Engineering and Public Affairs, Carnegie-Mellon University. B.S. 1951, University of Michigan; M.S. 1953, Ph.D. 1955, Carnegie Institute of Technology.

1. For an analysis of the products liability process and the role of the expert witness, see Weinstein, Twerski, Piehler & Donaher, *Product Liability: An Interaction of Law and Technology*, 12 DUQ. L. REV. 425 (1974) [hereinafter cited as Weinstein].

2. *Id.* at 442.

a product is "in a defective condition unreasonably dangerous to the user or consumer."[3] The comments following this section provide that a product is defective when "it is . . . in a condition not contemplated by the ultimate consumer,"[4] and describe unreasonably dangerous as "dangerous to an extent beyond that which would be contemplated by the ordinary consumer who purchases [the product], with the ordinary knowledge common to the community as to its characteristics."[5] This formulation focuses on the product as a functioning entity in the hands of the consumer; it is totally removed from the negligence approach, which emphasizes the manufacturer's conduct.

The *Restatement* standard is, however, a mixed blessing. Although it forces an examination of the actual environment of product use, it suffers from the fact that this examination is undertaken from the viewpoint of the ordinary consumer. The test suggests that if the ordinary consumer "contemplates" the danger, then the product is not unreasonably dangerous. Indeed, there is a strong argument that the *Restatement* language is but an updated version of the patent danger rule. This rule, which has come under heavy attack from both academic[6] and judicial quarters,[7] provides that a manufacturer has fulfilled all his duties to the consumer if the product's dangers are open and obvious. In many instances manufacturers have been absolved from liability when an obvious danger caused serious injury, even though that injury could have been averted by a design modification that would not have added significantly to the cost of the product or impaired its usefulness.[8] For courts seeking to rid themselves of every vestige of the patent danger rule, the adoption of the § 402A comments was fraught with risks. The language could too easily be misunderstood.

The California Supreme Court recently evidenced its unwillingness to permit this uncertainty to upset the very real gains made in strict lia-

3. RESTATEMENT (SECOND) OF TORTS § 402A (1965).

4. *Id.* comment g.

5. *Id.* comment i.

6. *See* 1 L. FRUMER & M. FRIEDMAN, PRODUCTS LIABILITY §§ 6.04, 7.02, 8.04 (1973); 2 F. HARPER & F. JAMES, THE LAW OF TORTS § 28.5 (1956).

7. *See* Dorsey v. Yoder Co., 331 F. Supp. 753, 759-60 (E.D. Pa. 1971), *aff'd sub nom.* Yoder Co. v. General Copper & Brass Co., 474 F.2d 1339 (3d Cir. 1973); Pike v. Frank G. Hough Co., 2 Cal. 3d 465, 473-74, 467 P.2d 229, 234-35, 85 Cal. Rptr. 629, 634-35 (1970); Palmer v. Massey-Ferguson, Inc., 3 Wash. App. 508, 516, 476 P.2d 713, 719 (1970).

8. *See* Patten v. Logemann Bros. Co., 263 Md. 364, 283 A.2d 567 (1971); Bolm v. Triumph Corp., 33 N.Y.2d 151, 305 N.E.2d 769, 350 N.Y.S.2d 644 (1973); Campo v. Scofield, 301 N.Y. 468, 95 N.E.2d 802 (1950). *See also* Twerski, *From Codling, to Bolm to Velez: Triptych of Confusion*, 2 HOFSTRA L. REV. 489 (1974).

bility theory. In *Cronin v. J.B.E. Olson Corp.*[9] the product under consideration was a hasp that failed to hold bakery trays in place when a bakery truck collided with another vehicle. There was evidence that one hasp was constructed of defective metal and thus gave way on impact, permitting the trays to come forward and strike the driver's back. The trial court instructed the jurors that they were to find for plaintiff if the hasp was defective and proximately caused the injury. Defendant argued that plaintiff should be required to prove that the hasp was unreasonably dangerous as well. The California court, however, reasoned that the "unreasonably dangerous" language of § 402A and the accompanying commentary "ring of negligence" and might deny a legitimate plaintiff a rightful cause of action: "[I]f, in the view of the trier of fact, the 'ordinary consumer' would have expected the defective condition of a product, the seller is not strictly liable regardless of the expectations of the injured plaintiff."[10] The court acknowledged that some standard of defectiveness is needed,[11] but it rejected unreasonable danger, apparently believing that the *Restatement* definition focuses too heavily on the ordinary consumer's expectation rather than on the product's defectiveness.[12]

A cynic might suggest that it was not necessary to throw out the baby with the bath water. The court could have disavowed the *Restatement* comments as misleading and established the rule that a product must be unreasonably dangerous, not as defined from the perspective of the ordinary consumer, but rather from the perspective of society making the ultimate judgment by balancing risk and utility.[13]

9. 8 Cal. 3d 121, 501 P.2d 1153, 104 Cal. Rptr. 433 (1972).
10. *Id.* at 132-33, 501 P.2d at 1162, 104 Cal. Rptr. at 442.
11. *Id.* at 134 n.16, 501 P.2d at 1162 n.16, 104 Cal. Rptr. at 442 n.16.
12. For a somewhat different view of the *Cronin* court's motivation, see Wade, *On the Nature of Strict Tort Liability for Products*, 44 MISS. L.J. 825, 839 (1973), suggesting that the court repudiated the *Restatement* formulation because the unreasonably dangerous standard implied a requirement of special or unusual danger. If Dean Wade is correct, the court should have substituted a different standard to supplant the misleading "unreasonably dangerous" formula. In fact, the court made no effort to enunciate a standard for the defect concept, merely suggesting that there are "useful precedents." 8 Cal. 3d at 134 n.16, 501 P.2d at 1162 n.16, 104 Cal. Rptr. at 442 n.16. It has drawn sharp criticism for this lapse. *See* Keeton, *Product Liability and the Meaning of Defect*, 5 ST. MARY'S L.J. 30, 30-32 (1973).
13. In a companion case decided the same day, Luque v. McLean, 8 Cal. 3d 136, 501 P.2d 1163, 104 Cal. Rptr. 443 (1972), the court emphasized that a products liability plaintiff need not prove that he was unaware of the defect at the time of the accident. *Luque* and *Cronin* together indicate that a product can be declared defective separate and apart from recognition by consumers and manufacturers of its potential dangers. If the danger recognition issue is to surface at all, it must be within the affirmative defense of assumption of the risk. Within the context of the *Luque* case, the court did not find

The net effect of the court's failure to adopt this rule is that the concept of defect in California now lacks meaningful content,[14] and it may now be true that defect, like obscenity in Justice Stewart's definition, will be discovered by sense impression. Unfortunately, "I know it when I see it"[15] will not suffice as a judicial standard for products liability.

A second formulation of the strict liability standard recently found expression in *Welch v. Outboard Marine Corp.*,[16] which involved allegedly inadequate safety guards on a power lawn mower. The court instructed the jury: "[A] condition is unreasonably dangerous so as to constitute a defective condition when it is so dangerous that a reasonable man would not sell the product if he knew of the risks involved."[17] This reasonable seller test also suffers from vagueness. Properly understood, the test does capture the essence of strict liability since the question is not whether a reasonable seller should have known of the risks but whether he would have sold the product if he had known.[18] The court and jury, acting as the reasonable seller's conscience, will determine whether the product belongs in the marketplace. Nevertheless, if the concern is possible misinterpretation of the strict liability standard, the reasonable-seller test may be too heavily defense oriented, and this test, too, has negligence overtones. To inquire whether a reasonable seller would have marketed the product if he had known of the risks shifts the focus to the vantage point of the seller, whose evaluation of

it necessary to consider the obviousness of the danger as one of the factors bearing on whether the product was defective. *See* text accompanying notes 21-28 *infra.*

14. *See* Culpepper v. Volkswagen of America Inc., 33 Cal. App. 3d 510, 109 Cal. Rptr. 110 (1973); *cf.* Holford, *The Limits of Strict Liability for Product Design and Manufacture,* 52 TEXAS L. REV. 81, 94 (1973). The court in *Culpepper,* a desigu defect case, was at a loss in attempting to evaluate the defect because there were no criteria readily available. Thus, the impact of *Cronin* was clearly felt.

15. Jacobellis v. Ohio, 378 U.S. 184, 197 (1964) (Stewart, J., concurring).

16. 481 F.2d 252 (5th Cir. 1973).

17. *Id.* at 253.

18. This test originated in Keeton, *Manufacturer's Liability: The Meaning of "Defect" in the Manufacture and Design of Products,* 20 SYRA. L. REV. 559 (1969). Dean Keeton suggested that

> [A] product ought to be regarded as "unreasonably dangerous" at the time of sale if a reasonable man with knowledge of the product's condition, and an appreciatiou of all the risks found to exist by the jury *at the time of trial,* would not now market the product, or, if he did market it, would at least market it pursuant to a different set of warnings and instructions as to its use. . . . Since the test is not one of negligence, it is not based upon the risks and dangers that the maker should have, in the exercise of ordinary care, known about. It is, rather, *danger in fact,* as that danger is found to be at the time of the trial that controls.

Id. at 568 (emphasis added). For an cven more extreme expression of the Keeton thesis, see Keeton, *Product Liability—Inadequacy of Information,* 48 TEXAS L. REV. 398, 407-09 (1970).

risk versus utility may understandably be skewed to his own perspective.

It is time to abandon the perspective of the reasonable consumer and the reasonable seller and formulate the strict liability question for what it is. The issue in every products case is whether the product *qua* product meets society's standards of acceptability. The unreasonable danger question, then, is posed in terms of whether, given the risks and benefits of and possible alternatives to the product, we as a society will live with it in its existing state or will require an altered, less dangerous form.[19] Stated succinctly, the question is whether the product is a reasonable one given the reality of its use in contemporary society.

In order to develop the issue of unreasonably dangerous defect within this formulation, it becomes crucial to understand the product's technical inadequacies as they relate to societal expectations. This approach requires no substantial departure from accepted legal criteria.[20] Dean Wade has suggested the following risk-utility considerations for determining the acceptability of a product:[21]

> (1) the usefulness and desirability of the product,[22] (2) the availability of other, safer products to meet the same need,[23]

19. The Eighth Circuit recently articulated these considerations in discussing the role of the expert in a design defect case:

> An expert witness is called primarily to aid the trier of fact in understanding evidence which is of a highly technical nature. His testimony is appropriate when his unusual knowledge, by reason of skill, experience or education may lend meaningful insights and better comprehension of technical evidence. Here plaintiff's theory was based on dangerous design of a highly complicated piece of machinery. Liability alleged from defective design encompasses many factors not generally relevant to ordinary negligence in tort cases. The comparative design with similar and competitive machinery in the field, alternate designs and post accident modification of the machine, the frequency or infrequency of use of the same product with or without mishap, and the relative cost and feasibility in adopting other design are all relevant to proof of defective design.

Hoppe v. Midwest Conveyor Co., 485 F.2d 1196, 1202 (8th Cir. 1973) (footnotes omitted).

20. A vast repository of judicial authority supports the conclusion that a risk-utility balancing approach must be undertaken. *See, e.g.*, Borel v. Fibreboard Paper Prods. Corp., 493 F.2d 1076 (5th Cir. 1973); Rivera v. Rockford Mach. & Tool Co., 1 Ill. App. 3d 641, 274 N.E.2d 828 (1971); Metal Window Prods. Co. v. Magnusen, 485 S.W.2d 355 (Tex. Civ. App.—Houston [14th Dist.] 1972, writ ref'd n.r.e.).

21. Wade, *Strict Tort Liability of Manufacturers*, 19 Sw. L.J. 5, 17 (1965) (footnotes added); *see* Wade, *supra* note 12, at 837-38.

22. *See* Hoppe v. Midwest Conveyor Co., 485 F.2d 1196 (8th Cir. 1973); E.R. Squibb & Sons, Inc. v. Stickney, 274 So. 2d 898 (Fla. Dist. Ct. App. 1973); Cochran v. Brooke, 243 Ore. 89, 409 P.2d 904 (1966).

23. Sutkowski v. Universal Marion Corp., 5 Ill. App. 3d 313, 281 N.E.2d 749 (1972); *see* Walker v. Trico Mfg. Co., 487 F.2d 595 (7th Cir. 1973), *cert. denied*, 415 U.S. 978 (1974); Culpepper v. Volkswagen of America Inc., 33 Cal. App. 3d 510, 109 Cal. Rptr. 110 (1973); Finnegan v. Havir Mfg. Corp., 60 N.J. 413, 290 A.2d 286 (1972).

> (3) the likelihood and probable seriousness of injury,[24] (4) the obviousness of the danger,[25] (5) common knowledge and normal public expectation of the danger (particularly for established products),[26] (6) the avoidability of injury by care in use of the product (including the effect of instructions or warnings),[27] and (7) the ability to eliminate the danger without seriously impairing the product's usefulness or making it unduly expensive.[28]

The evidence necessary to address the appropriate elements of these criteria should be overtly advanced by both parties in a strict liability action.[29] The conclusion on the defectiveness issue that would emerge

24. *See* Robbins v. Alberto Culver Co., 210 Kan. 147, 499 P.2d 1080 (1972); Berkebile v. Brantly Helicopter Corp., 219 Pa. Super. 479, 281 A.2d 707 (1971).

25. *Cf.* Campo v. Scofield, 301 N.Y. 468, 95 N.E.2d 802 (1950) (negligence; elevating this consideration into an absolute duty rule). *See also* Patten v. Logemann Bros. Co., 263 Md. 364, 283 A.2d 567 (1971); Parsonson v. Construction Equip. Co., 386 Mich. 61, 191 N.W.2d 465 (1971); Bolm v. Triumph, 33 N.Y.2d 151, 305 N.E.2d 769, 350 N.Y.S.2d 644 (1973). For cases abandoning the patent danger test but still considering the obviousness of the danger as a factor in evaluating the product under a risk-utility theory, see Dorsey v. Yoder Co., 331 F. Supp. 753 (E.D. Pa. 1971); Pike v. Frank G. Hough Co., 2 Cal. 3d 465, 467 P.2d 229, 85 Cal. Rptr. 629 (1970). For interplay between risk-utility theory and assumption of the risk as a defense, see Twerski, *Old Wine in a New Flask—Restructuring Assumption of the Risk*, 60 IOWA L. REV. 1 (1974). *See also* Keeton, *Product Liability—Inadequacy of Information*, 48 TEXAS L. REV. 398, 399-400 (1970).

26. *See* Zambrana v. Standard Oil Co., 26 Cal. App. 3d 209, 102 Cal. Rptr. 699 (1972); Cornelius v. Bay Motors, Inc., 258 Ore. 564, 484 P.2d 299 (1971).

27. *See* Davis v. Wyeth Labs., Inc., 399 F.2d 121 (9th Cir. 1968); McCormack v. Hankscraft Co., 278 Minn. 322, 154 N.W.2d 488 (1967); Incollingo v. Ewing, 444 Pa. 263, 282 A.2d 206 (1971).

28. Finnegan v. Havir Mfg. Co., 60 N.J. 413, 290 A.2d 286 (1972); *see* Horn v. General Motors Corp., 34 Cal. App. 3d 773, 110 Cal. Rptr. 410 (1973); Rios v. Niagra Mach. & Tool Works, 12 Ill. App. 3d 739, 299 N.E.2d 86 (1973); Coger v. Mackinaw Prods. Co., 48 Mich. 113, 210 N.W.2d 124 (1973); McCormack v. Hankscraft Co., 278 Minn. 322, 154 N.W.2d 488 (1967). *See also* Dreisonstok v. Volkswagenwerk, A.G., 489 F.2d 1066, 1072-73 (4th Cir. 1974) (footnotes omitted):

> Price is, also, a factor to be considered, for, if a change in design would appreciably add to cost, add little to safety, and take an article out of the price range of the market to which it was intended to appeal, it may be "unreasonable" as well as "impractical" for the Courts to require the manufacturer to adopt such change. Of course, if an article can be made safer and the hazard of harm may be mitigated "by an alternate design or device at no substantial increase in price", then the manufacturer has a duty to adopt such a design but a Cadillac may be expected to include more in the way of both conveniences and "crashworthiness" than the economy car.

29. The suggestion that a full exposure of risk-utility considerations occur in the trial does not necessarily lead to the conclusion that the jury should be specifically instructed concerning those considerations. In traditional negligence cases the court considers risk-utility criteria in the first instance in deciding whether reasonable men could differ regarding whether the defendant's conduct was substandard. *See* James, *Functions of Judge and Jury in Negligence Cases*, 58 YALE L.J. 667 (1949). When the issue is submitted to the jury for its consideration under the "reasonable man" test, society seeks the panel's intuitive judgment concerning the acceptability of the defendant's conduct.

from the trier of fact as a subjective amalgam of these elements would be the sought-for expression of societal acceptability of the product as is or in a less dangerous form. It would give substance to the *Restatement*'s necessary standard of a "defective condition unreasonably dangerous to the user."

Each of the elements suggested by Dean Wade has been explicitly expressed and considered in appellate opinions. There is no clear indication, however, that the courts view the blending of all the appropriate elements as the single standard for unreasonable danger. Were the courts to move toward this perspective, the concern over both the reasonable consumer and reasonable seller approaches to the unreasonable danger standard would be substantially mitigated.

II. The Technological Expert

In products liability litigation the determination of liability begins by focusing on some perceived deficiency in the product. The ultimate resolution of the question, however, requires a much more searching inquiry. Although a technically feasible alteration in a product design might have prevented injury, the product cannot be condemned on that basis alone. The conclusion of unreasonably dangerous defect must emerge as an amalgam of the appropriate elements of risk-utility theory.[30] The broad considerations evoked by the risk-utility approach

Since by this point the trial judge would already have determined that sufficient evidence exists to hold the defendant liable, there is no need to set before the jury the premises of the risk-utility theory.

Similarly, in a strict liability case premised on the concept of unreasonable danger, the jury need not be instructed specifically on the risk-utility considerations. This fact should have no bearing, however, on the determination of whether these criteria must be adequately addressed throughout the trial. The decision not to instruct on risk-utility considerations proceeds from a fear that the jury might lay aside its own intuitive judgment. To insist that the trade-offs be exposed to the jury, however, amounts to a determination that a prima facie case cannot be established unless all of these considerations are explicitly treated.

30. Risk-utility theory finds its principal application in questions of design defect. In a true production defect situation, the plaintiff establishes that an identified production flaw precipitated the product failure and that this failure caused the injury. Risk-utility theory has no relevance in these situations since the product has not met the manufacturer's own internal production standards. In those instances where the alleged production flaws have promoted product failure after substantial use, however, the question of defect must be framed relative to expected *performance* standards of the product rather than the *production* standards used by the manufacturer. The focus in addressing expected standards of performance is the reasonable expectation of the consumer, which necessarily will reflect questions of societal significance. When risk-utility theory emerges in this manner in an alleged production defect case, in reality a design defect question is being approached from a different point of view.

The *Cronin* court abandoned the standard of "unreasonable danger" in the context impose greater demands in terms of the identification and role of the appropriate expert witness. Within the context of these more pervasive questions, then, the mechanism for selection and qualification of the technical expert in products liability litigation must be reexamined.

A. *The Role of the Expert*

The expert in a products liability case must address the evidentiary elements necessary to establish or refute the defect and unreasonable danger criteria and the causation issue. While a technological expert can often easily trace a product's failure or malfunction to either manufacture or design, this alone is generally insufficient to establish liability. Thus, in addition to more purely technical matters, both parties' experts must consider the general societal values reflected in risk and utility considerations. For example, if a production defect is alleged, experts must address the following elements: (1) identification of the flaw or flaws relative to manufacturing or physical property standards; (2) evidence that the product's failure or malfunction is directly attributable to the flaws; (3) the relationship of the failure or malfunction to the product's expected performance standards;[31] and (4) the causal link between the failure or malfunction and the injury. Similarly, a design defect case would require that the experts consider: (1) the identification of the design flaw or flaws that occasioned the injury; (2) the enumeration of alternative design features proposed to reduce the danger; (3) the evaluation of these features relative to the expected performance standards of the product, as well as their effect upon the product's subsequent usefulness and cost; (4) the compari-

of a production defect case. The allegedly defective hasp in that case could be judged against seven other hasps in the truck that had been manufactured from clearly nondefective metal. Thus, the court's failure to establish a standard for defectiveness was not crucial to the finding of a defect in that case. The measure for defective condition was simply the manufacturer's norm, as established by the other hasps. A strong argument can be made for the necessity of the unreasonable danger test in production defect cases as well. *See* Weinstein, *supra* note 1, at 433-34 & n.14. The problem with the *Cronin* case is that it abandoned the unreasonable danger standard (and, by implication, risk-utility considerations) for both production and desigu defect cases. Absent risk-utility criteria, there is no basis for judging the defectiveness of a design.

31. In those instances where no physical evidence exists and inferences of defect can be drawn from the mere occurrence of the accident, plaintiff's proof need not be as specific as outlined in the first three items. *See, e.g.*, Henningsen v. Bloomfield Motors, Inc., 32 N.J. 358, 161 A.2d 69 (1960); Codling v. Paglia, 32 N.Y.2d 330, 298 N.E.2d 622, 345 N.Y.S.2d 461 (1973); MacDougall v. Ford Motor Co., 214 Pa. Super. 384, 257 A.2d 676 (1969).

son of this product with other similar products; and (5) the causal link between the design deficiency and the injury.

Because of the scope of evidentiary material implicit in these delineations, a single expert may not possess the requisite expertise to evaluate properly each element. It is not unreasonable, therefore, to suppose that a number of individuals with distinct areas of expertise may conjunctively address the individual evidentiary elements of proof. However, each side must employ at least one expert who is capable of synthesizing the diverse elements necessary to reach the ultimate legal conclusions. Whether or not the expert is permitted to opine explicitly on the conclusions of defect, unreasonable danger, and causation is not critical as long as the thrust and scope of his investigation and testimony reflect an understanding of the legal criteria.

Thus, an expert who is called solely to testify that a proposed design alternative would have prevented an accident is not fulfilling the expert's critical role. Nonetheless, an examination of trial transcripts conducted by the authors[32] reveals that the posture of proof of an unreasonably dangerous and defective condition routinely employed by experts in products litigation has been narrow in focus. While a few courts have recognized that a risk-utility trade-off is not merely preferable but indispensable to adjudication of the strict liability question,[33] the common approach has been a tunnel-visioned appraisal of a single factor, such as the availability of some alternative[34] or the undisputed fact that the product caused the injury.[35] Indeed, the area of expertise of the person who testifies limits the range of evidence that he can present and his role in the trial format. The arrival of a safety expert in the courtroom foreshadows a statement that the product is defective and unreasonably dangerous because it caused an injury.[36] All too often the metallurgist's presence heralds the discovery of "cracks" or "porous conditions," which the jury is invited to regard as sufficient evidence of defectiveness (with the further implication of unreasonable danger).[37] And the too-frequent surfacing of the ubiquitous journeyman expert who will fashion his credentials as

32. Weinstein, *supra* note 1.

33. *See* Mahoney v. Roper-Wright Mfg. Co., 490 F.2d 229 (7th Cir. 1973); Hoppe v. Midwest Conveyor Co., 485 F.2d 1196 (8th Cir. 1973); Sutkowski v. Universal Marion Corp., 5 Ill. App. 3d 313, 281 N.E.2d 749 (1972).

34. Weinstein, *supra* note 1, at 496-505.

35. *See* Dowdell v. U.S. Indus., Inc., 495 F.2d 641 (6th Cir. 1974).

36. *Cf.* Kaczmarek v. Mesta Mach. Co., 463 F.2d 675 (3d Cir. 1972).

37. *See* Weinstein, *supra* note 1, at 533-50.

well as his conclusions "to fit the crime" is lamentably predictive of a superficial conclusion.[38]

There is little indication that current practice permits, let alone encourages, the selection of an expert who is capable of evaluating the risk-utility elements that constitute factors in the unreasonably dangerous and defective condition test. Yet among all possible witnesses, only the appropriate technological expert can speak to these broad questions.

B. Identification and Qualification of the Appropriate Witness

A determination of the expertise necessary for qualification in a given case must be based on the character of the elements of proof to be addressed. Certain elements may be primarily quantitative in character, for example, defining a production flaw as a deviation from manufacturing standards, or isolating the absence of a guard as a design flaw. Depending on the nature of the case, however, there may be a progression from the more quantitative factors to those that involve substantial qualitative value judgments, requiring a greater breadth of background for the exercise of expert judgment. For example, in judging the adequacy of a product's performance within the context of the consumer's justified expectations of product behavior, the expert must demonstrate a capacity to define or delineate standards of performance that may encompass subjective as well as objective judgmental criteria. The expert's evaluation of the economic and technological trade-offs would result in such standards.[39] This type of expanded capability is also required of the expert in the design defect case who will testify about the effect of proposed design alterations on the product's usefulness and economic viability. As the qualitative dimension of the testimony increases, there is a concomitant need for the expert to demonstrate a more extensive educational and experiential background.

Because the scope of the technological expert's testimony in ad-

38. *See* Cronin v. J.B.E. Olsen Corp., 8 Cal. 3d 121, 501 P.2d 1153, 104 Cal. Rptr. 433 (1972).

39. For an example of an appropriate consideration in determining standards of performance, see the third issue in example 2, *infra*. Consideration of the expected lifetime of a truck spring will effectively separate an alleged production defect from a design defect. Thus, for the expert to reach a conclusion, he must first make tentative determinations regarding the lifetime of the spring, *i.e.*, a standard of performance for the product. If this determination has been implicit in his couclusion, it should be explicit in his exposition.

dressing the unreasonably dangerous defect question ranges from quantitative matters of a purely technological nature to the more qualitative dimensions of risk and utility, the technological expert is fundamentally distinguished from, for example, the medical expert, and thus is more difficult to identify. This difficulty is compounded by the broad range of expertise available in the technological area. Depending on the issue, the appropriate expert may be selected from a range that includes auto mechanics, mechanical engineers, bakers, and home economists. The attention devoted to the medical expert as a prototype for establishing qualifications of experts generally arises from the widespread use of medical testimony in litigation. There is, however, no justification for utilizing criteria endemic only to the medical profession. Whether the medical expert speaks to questions of improper treatment procedures or to questions of medical cause of the injury, his qualitative judgments generally do not involve issues of broad societal significance. The questions of an injured party's past trauma and prognosis are relevant only to the specific medical case at issue, and the expert opinion therefore is focused precisely on the variables of the individual case. Because the medical expert's testimony is more narrowly quantifiable than that of the technological expert, qualifications of the appropriate technological expert are less readily categorized.

Rarely will there be a precise matching of the expert's prior education and experience and the particular expertise needed in a given situation. Consequently, the expert must be capable of and indeed must have undertaken sufficient self-education to enable him to address the particular aspects of a given problem. The required special knowledge would ordinarily be acquired by ad hoc edueation undertaken for specific litigation. Such self-education may be the essential ingredient in establishing a given expert's qualifications to address the relevant questions.

The capacity for this training must be consistent with the expert's background. In determining whether a technological witness possesses the requisite capacity for self-education, the pervasive discipline underlying a given issue must be identified. If that discipline falls within the witness's general qualifications, the technologist may readily acquire the additional knowledge, data, and skill from qualified sources. Sources available to the technologist include such materials as drawings and specifications, methods utilized in the manufacture of a product, and literature pertinent to the particular product and similar products. Additionally, he would systematically observe the product and similar products in use and in the environment of use. To the extent necessary, he would acquire from other disciplines the additional information necessary to address adequately the questions of defect and causation. If, however, in the process of seeking self-education, the technologist discovers that the pervasive discipline involved is not within his basic qualifications, he is obliged to defer to one more qualified in that discipline.

The self-education requirement reveals another and perhaps more intrinsic difference between the technological expert and the medical expert: adaptability of expertise. For example, if an injury is associated with a neurological function, a physician whose principal experience has been in hematology would most likely be an inappropriate witness. On the other hand, an engineer with experience in the electromechanical machinery of steel plants may well be qualified to address the technical aspects of a carton-stacking machine in a soft drink bottling plant because the basic principles underlying electro-mechanical machinery design inhere in both products. While the particular function of such components as shafts, bearings, gears, switches, controls, and hydraulic cylinders may differ, the fundamental considerations in the design of these elements are identical. More fundamentally, the principles of stress analysis, material behavior, heat transfer, fluid flow, electricity, and thermodynamics pervade the design of all technological devices. In contrast, the physician specializing in hematology would not be equally capable of addressing questions associated with a neurological injury, simply because no comparable unifying principles have as yet been identified in the human physiology area. It is not suggested that a hematologist could not acquire the requisite expertise in neurological medicine, but the self-education necessary for such an undertaking would not be feasible. Therefore, qualification of the medical expert must of necessity generally be defined within the context of a narrow specialty. On the other hand, when the issue is the absence of a guard at the point of operation in a carton-stacking machine, the expert who is familiar with steel plant machinery (including safety features thereof) may readily be capable of applying his expertise to a carton-stacking machine in a bottling plant. Having established his mastery of the underlying technological principles, the expert need demonstrate only his acquisition of special knowledge relating to the peculiarities of the particular product.

Thus, because of the necessarily broad scope of the technologist's testimony and the adaptability of technological expertise (which makes impossible a precise, readily discernible correlation between product type and appropriate expertise), the identification and qualification of the technological expert presents difficulties. It is suggested, however, that the critical determinants of the expert's qualifications are in fact the *precise technical issues* in controversy in the litigation. The appropriate medical expert can be selected with relative facility because of the specificity with which medical issues are generally formulated. If technical issues are defined with a comparable precision, technological experts can be identified and qualified with greater certitude than is presently possible. In part, the necessity for exact delineation of the technical issue arises from the difficulty of assessing the appropriateness of the broad range of skills, education, and experience offered in support of a potential witness's qualifications. When viewing the qualification of the expert from the perspective of precisely drawn technical issues, the court can more readily determine the relevance of a given expertise to the particular situation. Continuing with the illustration of the expert on steel plant machinery, in a case involving carton-stacking machines this expert need not qualify solely on the basis of specific experience in the design of carton-stacking machines if the issues are, for example: (1) the technical feasibility of a protective device at the machine's point of operation; (2) an evaluation of the protective device relative to the machine's expected performance standards; (3) the safety device's effect upon the machine's subsequent usefulness and cost; and (4) the causal link between the design deficiency and the injury. Because of the generic similarity in the considerations relevant to the efficacy and feasibility of safety features, a person with basic expertise in machine design may, upon demonstrating the appropriate self-education, qualify to speak to these issues. An essential element of this self-education would be familiarization with the operation of the bottling plant and the carton-stacking machine's role within the plant. This process should include an examination of the basis upon which the machine operators are compensated (for example, pay-incentive plans providing a higher wage while the machine is operating) and a determination of whether the machine is being used as anticipated.

Although this discussion has focused on experts in design defect cases,[40] the considerations in the identification and selection of ex-

40. In a provocative article, Professor Henderson attacks the courts' ability to set product safety standards in cases where manufacturers have in effect set standards by making conscious design choices. Henderson, *Judicial Review of Manufacturers' Conscious Design Choices: The Limits of Adjudication*, 73 COLUM. L. REV. 1532 (1973).

perts for production defect cases are substantially analogous. Additionally, this approach to establishing qualifications recognizes the variety of backgrounds, skills, and experience that potential witnesses will offer in support of their expertise in both production and design defect cases. Consequently, the suggested premises provide a viable basis from which to formulate more appropriate guidelines for the selection and qualification of the technological expert in products liability litigation. A series of examples follows to illustrate the suggested approach to the selection of experts.

Example 1. A printer-slotter machine prints labels and cuts and scores pieces of corrugated cardboard, which are later assembled as boxes. There are two sets of printing rolls for two-color operations. These rolls and the knives and scores are driven by a single motor located at the feed end of the machine. The feed and exit ends of the machine can be separated in order to change the dies, exposing two vertical "walls" of rolls on either side of an open passageway thirty inches wide. The machine separation mechanically disconnects the motor from both the rolls and the knives and scores at the exit end of the machine, but the rolls at the feed end can continue to operate. At the time of the injury, plaintiff-employee was walking through the open passageway to obtain a tool located on the other side of the ma-

The author divides generically dangerous products into two classes: those that are dangerous because of inadvertent design error, and those in which conscious design choice has produced the danger. Professor Henderson contends that courts are not institutionally suited to establish product safety standards in cases involving the latter type of product; such decisions are polycentric and require an understanding of trade-offs made under a cost-benefit analysis. Henderson reviews a large number of appellate decisions dealing with generically dangerous products and concludes that few courts have actually set product safety standards in cases where it is clear that the manufacturers considered various alternatives and rejected the safer design. The majority of cases in which courts have set product safety standards involved inadvertent design error. In these cases courts have found it unnecessary to formulate their own standards, Henderson concludes, because they can rely on specific design standards set by "the collective managerial authority of the engineering profession." *Id.* at 1550.

Professor Henderson's thesis is an engaging one. Recently several commentators have noted the open-endedness of the design defect inquiry. *See, e.g.*, Hoenig & Goertz, *A Rational Approach to "Crashworthy" Automobiles: The Need for Judicial Responsibility*, 6 Sw. U.L. Rev. 1 (1974); Holford, *supra* note 14. There are, however, more compelling reasons for the courts' failure to intrude in conscious design decisions. Simply stated, when the defendant has actually considered, weighed, and tested alternatives, the quality of plaintiff's expert testimony is generally inferior not only in degree but in kind to that of defendant. Plaintiff proceeds by suggesting theoretical alternatives; his ability to test their efficacy is limited by economic realities. Plaintiff has no research and development capabilities to match those of defendant. There is thus "no contest" between the adversaries. If plaintiff could bring equal resources to the courtroom, rational adjudication under a cost-benefit (risk-utility) theory would be feasible.

chine. All employees worked on a pay incentive plan that paid a lower hourly rate during machine downtime than during production time. Plaintiff had left the motor running so that an automatic washing attachment could clean the set of rollers at the feed end of the machine while his co-employee reset the knives and scores on the inactive exit end of the machine. His arm caught in the rolls rotating on the feed side of the passageway.

Plaintiff alleged as a design flaw the absence of a switch that would automatically disconnect power to the machine motor whenever the feed and exit ends of the machine were separated. If the jury is to determine that this constitutes a design defect, plaintiff's expert must address the following issues:

(1) Is such a switch technically feasible?

(2) Are there alternative design alterations, such as a guard enclosing the rotating rolls, that could have reduced the likelihood of this injury?

(3) How do all proposed alternative designs compare, relative to the following broad questions:

(a) Is it necessary to open the machine in order to change dies?

(b) Are there conditions that necessitate operation of the feed end when the machine is open?

(c) What were the time sequences involved in setting up, cleaning, and operating the machine within the plant's pay incentive scheme?

(d) What would be the additional costs of each proposed alternative?

(e) Could the proposed alternatives be circumvented with comparative ease, thus obviating their effect?

(f) Would usefulness of this machine in this plant environment be diminished by addition of the proposed design changes?

(4) Are there other machines, performing the same or similar functions, that utilize any of the proposed design modifications?

(5) If there are such machines, are they used in similar or different environments; for example, is a pay incentive plan employed?

(6) Knowing the location and direction of the rolls' rotation,

what is the probability that the accident happened in the manner described by the plaintiff?

The knowledge necessary to answer these questions provides a measure of the qualifications required of those called to give expert testimony. Ideally, the expert here would be a design engineer with substantial experience in designing a wide range of electro-mechanical production equipment and, in particular, prior success in designing, manufacturing, installing, and maintaining printer-slotter machines in all environments. Additionally, the prospective witness would have experience in production planning and scheduling and in establishing piece-part work rates. This expertise would be the product of formal education and practical experience in all of the areas cited.

It is highly doubtful that such a person can be found in the defendant's employ, let alone in the open market of available experts. Realistically, therefore, the appropriate expert is one who can demonstrate competence in the design of electro-mechanical production equipment (not necessarily printer-slotter machines). He must also exhibit, through education or diversity of experience, the capacity to acquire knowledge germane to an understanding of the functioning of the printer-slotter machine and its utilization within its specific environment. In addition to the more usual industrial experience, diversity of experience can include the ability to communicate, through teaching, both principles and practice of machine design. The expert's capacity for self-education must include not only the ability to understand the functioning of the particular machine, but also the ability to assess comparative costs of alternative design modifications and the effect of these modifications upon the machine's utility. Finally, he must show that he has undertaken this self-education.

Example 2. A one-year-old tractor-trailer truck that had traveled 90,000 miles collided with an automobile. Following a slight impact between the truck's right front end and the car's left rear end, the truck swerved off the right side of the road, struck an embankment, and overturned. The plaintiff-truck driver reported that the right front end of the truck "dropped down" prior to its impact with the car. Examination of the truck following the accident revealed that the right front leaf spring was completely broken just behind the front shackle connection. "Gouge marks" were discovered across the surface of the main leaf of the spring in the vicinity of the fracture surface. Additionally, the microstructure of the steel on the fracture faces near the leaf surface appeared to be significantly different from the microstructure of the remaining material in the leaf. Plaintiff contended that these two conditions were manufacturing flaws. He alleged that the gouge marks resulted from using a worn mandrel in fabricating the front eye of the spring and that the aberrant microstructure near the surface resulted from improper quenching of the spring leaf during the heat-treating operation.

Plaintiff claimed that either or both of these flaws would contribute to premature spring failure, which would cause the truck to go out of control. Thus, he insisted that the spring was defective and unreasonably dangerous. If these flaws are ultimately to rise to the level of unreasonably dangerous defects, plaintiff's experts must address the following issues:

(1) Did the gouge marks result from an aberration in the manufacturing process, or do these marks routinely appear in the standard manufacturing process?

(2) Was the variation in the microstructure caused by an aberration in the quenching process, or does this variation routinely appear as a result of normal and expected decarburization near the surface?

(3) If either or both of these conditions can be characterized as flaws, measured by manufacturing and physical property standards, were they the principal or most probable cause of the spring failure, either by fatigue or single-load impact?

(4) Can the fracture of a truck spring after 90,000 miles of use in one year be classified as premature failure?

(5) What circumstances caused the truck to go out of control?

   (a) At what point in the chain of events was it most probable that the spring failed; that is, prior to impact with the car, upon impact with the car, or as a result of impact with the embankment?

   (b) Could the failure of the spring prior to impact with the embankment cause the truck to go out of control?

   (c) To what extent did driver error contribute to loss of control and the ultimate accident?

To address the first three questions, the expert must possess a background in metallurgy with demonstrable skill in the mechanics of failure of ferrous material. He must also exhibit an understanding, through either experience or self-education, of the spring manufacturing process, in order to diaguose whether the alleged deficiencies arose from the production process. A witness qualified to address the question of premature failure, in the absence of established standards for the lifetime of truck leaf springs, would be one who is familiar with the historical performance of similar springs. This could be a person who has actually been engaged in truck maintenance for a reasonable period of time. Alternatively, such evidence could be gathered from several sources and introduced by an expert who has the requisite capacity to comprehend the nature of the question and to interpret the data.

The issue of causation should be addressed by a person with a background in those aspects of mechanical engineering that would enable him to understand prior metallurgical testimony and integrate it with eyewitness accounts of the truck's behavior; he should also be able to assess the effect of spring failure on the driver's ability to control the truck. Clearly relevant to this task are an understanding of vehicle dynamics and the ability to estimate impact and failure forces on the truck-spring system. The prospective witness must also bring to the role of synthesizing these diverse evidentiary elements a breadth of experience or education sufficient to permit him to address the issues of unreasonably dangerous defect and probable cause of the accident.

Example 3. The allegedly defective product was a baby carriage that would fold upon manual release of a latch mechanism on one side of the supporting structure. At the time of the injury, a child under a babysitter's care occupied the carriage. The babysitter was seated next to the carriage, rolling it back and forth, with her foot resting on one of the carriage wheels. Her foot inadvertently engaged the latch mechanism, causing it to release. The carriage collapsed, injuring the child.

Plaintiff alleged that the latch was improperly designed. If the jury is to find the latch defective, plaintiff's expert must address the following issues:

(1) What are the basic considerations in the design of this type of latch mechanism, with particular reference to the following:
  (a) location;
  (b) the direction and magnitnde of the force necessary to activate;
  (c) the trade-offs between complexity, redundancy, and ease of use, and safety;
  (d) the effectiveness of a possible guard around the latch mechanism?

(2) Within design constraints, are there any alternative designs that would be less dangerous than the one in question?

(3) What effect would those alternative designs have upon the cost and utility of the baby carriage?

(4) Are there baby carriages marketed with features similar to the proposed alternative designs?

(5) If one of the proposed design alternatives had been incorporated in the carriage, would the injury have been prevented?

The general background required of an expert in this case would include knowledge of the geometry of linkages and the capacity to calculate the forces that would be applied to the linkages from external loading. These skills are necessary in order to design such diverse products as typewriters, card tables, automobile hood release mechanisms, and the Apollo rocket docking mechanism. Those whose knowledge is based on devices other than the carriage release latch can apply it to the latch problem only after undertaking a regimen of self-education.

The requisite self-education would entail review of alternative linkage and latch designs, as described in patent literature as well as open literature. Calculation of all forces that realistically could have been applied to the latch mechanism is also required. Within the context of these additional studies, the expert must acquire a reasonable capacity to assess the trade-offs among complexity of design, ease of use, and cost increment.

Example 4. A child's toy, used exclusively for indoor play, contained a glass surface measuring over thirty-six square inches. While playing with this toy, the child stumbled and fell on the glass surface, breaking it and injuring his arm near his elbow.

If it is reasonably foreseeable that a child within the class of anticipated users would carry the toy around without recognizing or guarding against the danger that it poses if he should trip and fall, the product's standard of performance should be one that avoids an unreasonable danger to the child-user who merely acts as expected. Thus, the principal issue at trial would be the reasonably expected standard of performance of a piece of glass on the surface of a child's toy. The expert would then have to address the following:

(1) What is the reasonable limit of impact loads that the material used for the toy's surface should withstand when the toy is dropped?

(2) What is the reasonable limit of impact loads that the material should withstand upon contact with a child's body?
(3) If standards for performance of glass under these conditions exist, are they consistent with the standards established in (1) and (2)?
(4) Does the present design of the glass surface generally fall within the performance parameters indicated either in (1) and (2) or in (3)?
(5) If the data found in (1) and (2) are offered as the requisite standard, can the design parameters of the glass be adjusted to meet the suggested level of performance?
(6) Is there any material that could be substituted for the glass that would meet the impact-load criteria as well or better?
(7) What would be the cost and utility effects of constructing the toy from a material, either glass or a substitute, that meets the expected impact-load standard of performance?

The general background of the appropriate expert in this case would include experience in the behavior of materials under a variety of loading conditions. He must demonstrate knowledge of the manner in which loads and forces would be transmitted to the glass. Additionally, he must exhibit the capacity to devise, implement, and interpret reasonable experiments to adduce the impact-load capacity of various materials.

The self-education required in this instance could be extensive. Absent any standard test procedures or standards for the impact load that glass should absorb before fracture, the expert would have to select a procedure that would simulate the reasonably foreseeable occurrence: a child carrying the toy, falling, and striking his elbow on the glass surface. The expert should demonstrate that there is sufficient weight and dimension data on children with which to calculate the force of a falling child and that this could be simulated in a drop test. Additionally, he would indicate the method used to simulate the padding effect of the flesh over a child's bone.

In establishing the scope of his self-education, founded upon a general knowledge of the underlying scientific principles, the expert not only demonstrates his ability to address the specific technical issues, but demonstrates as well his capacity to describe expected standards of product performance. Also required, however, is an expertise suitable to confront the issues of ultimate cost, based upon the design changes necessary to meet the proposed performance standards. While this expertise could be furnished by the same person, the background necessary to address these questions would include general experience in the design and production of consumer goods, which may require obtaining the services of a second expert.

Example 5. The carrier over the rear fender of a single-seat motorcycle is used to hold packages being transported by the driver. It is fastened to the motorcycle by means of a metal bracket. While riding a motorcycle with a load securely fastened to the carrier, the plaintiff was forced off the road, and the cycle collided with a tree. Because of the failure of the attaching bracket, the impact caused the carrier to break loose; the loaded carrier struck the driver in the back, increasing the severity of his injuries.

Preliminary examination of the supporting bracket revealed apparently extreme porosity within the structure of the metal at the fracture surface. Plaintiff suggested that this flawed condition caused the bracket to break upon the motorcycle's impact. This contention raises the issue of "crashworthiness," or the appropriate standards of performance for the carrier bracket. The points at issue may be delineated as follows:

(1) Did the observed porosity weaken the metal to a degree significant enough to cause the bracket's failure?

(2) Is the observed porosity a true flaw or inherent in the nature of that particular material?

(3) Regardless of whether the porosity was a flaw, should the bracket be expected to withstand the conditions of the accident?

(4) Was the package load supported by the carrier, which was attached to the bracket, within the anticipated range of loadings?

(5) If the material used in the bracket was not flawed, could the bracket failure have been prevented by a design alteration in either structure or material?

(6) If bracket failure could have been prevented only by redesign, what would be the alteration's effect upon the bracket's subsequent usefulness and cost?

While it is obvious that a person with a background in metallurgy is needed to answer the first two questions, the methods by which he proposes to elicit the necessary data are essential elements in establishing his qualifications. Subjective observations of the metallic surface are insufficient. They must be supported by other indicia, such as examination of similar parts constructed out of the same material. Unless it is obvious and generally uncontroverted that porosity weakens the material, experimental testing would be needed to establish the effect of porosity on the material's strength or impact resistance.

To address the questions on the effect of redesigning the bracket, the witness should demonstrate a background in machine member design, though not necessarily carrier bracket design. This would require the ability to estimate dynamic loadings and an understanding of the response of materials to those loadings. The witness must also exhibit the capacity to make reasonable judgments concerning the incremental cost changes and to assess the effect on the vehicle's utility. Possibly no single expert can address both the basic metallurgical questions and the design questions; thus, two experts would be required. One of them, probably the latter, would address the aspects of crashworthiness, elicited in the third and fourth questions, as elements of the product's expected standard of performance.

It is not suggested that any expert can bring to these matters qualifications that give him a greater intrinsic ability to answer questions of ultimate social significance than are brought by the jurors who must ultimately answer them. Nonetheless, the expert should state for the jury's benefit his appraisal of whether the bracket should be expected to withstand this and similar accident conditions, given the frequency of vehicular collision. This exercise is not designed to intrude upon the factfinding function of the jury, but rather to place the expert's technological evidence within a context appropriate to a determination of the presence or absence of an unreasonably dangerous and defective condition in the product. While there may not be requisite qualifications for considering the social dimension of expected performance standards, only the expert qualified to address the related issues of the product's economic viability and usefulness should be permitted to provide the context testimony of standards of performance.

III. Conclusion

The purpose of qualifying a witness as a technological expert is to demonstrate his capacity to address subject matter beyond the ordinary experience of the layman, whether judge or juror. The ultimate objective of his testimony is to raise the level of comprehension of remotely perceived technological material. The problems involved in qualifying the witness to give expert testimony arise both from the scope of evidentiary material that may have to be addressed and the diverse range of technological skills offered by potential witnesses.

An attempt to formulate a rule that addresses the multi-faceted complexities of qualification of the expert witness is found in rule 702 of the Proposed Federal Rules of Evidence: "If scientific, technical, or other specialized knowledge will assist the trier of fact to understand the evidence or to determine a fact in issue, a witness qualified as an expert by knowledge, skill, experience, training, or education, may testify thereto in the form of an opinion or otherwise."[41] This proposed rule recognizes the broad scope of evidentiary material and the diversity of technological skills that may be involved, but in so doing provides minimal assistance to the court in the exercise of its discretionary power to pass on a witness's qualification.

It is not feasible to formulate a single rule that is at once sufficiently broad and adequately precise to afford any meaningful assistance to the trial court. Instead, we have enunciated what we consider to be the basic premise for qualification of the technological witness: the precise delineation of the technical issues must provide the focus for the evaluation of the expert's credentials. The parties, counsel, and prospective witnesses will identify the technical issues before the court, perhaps most appropriately at a pretrial hearing, as the initial step in the qualification procedure. Thereupon the witnesses must demonstrate that their education, background, and skills, together with the necessary self-education, would permit them to couple their basic expertise with those technical questions at issue. This task is not an easy one. The court must apply a three-stage qualification procedure to the prospective expert witness. Initially, the court must be satisfied that the pervasive discipline, as identified by a given issue, is within the scope of the witness's background skills. Then the prospective witness must persuade the court that the self-education that he has undertaken involves a legitimate application of his basic skills. Finally, the witness must demonstrate that he has been sufficiently thorough in acquiring this self-education to achieve a level of qualification consistent with the technical issues that he will address. The court may, at any stage, find the expert's qualifications inadequate and may either limit the scope of his testimony or reject him as an inappropriate witness.

41. PROPOSED FED. R. EVID. 702 (1973). For a detailed treatment of the effect of the proposed rules on products liability litigation, see Mitchell, *The Proposed Federal Rules of Evidence: How They Affect Product Liability Practice*, 12 DUQ. L. REV. 551 (1974).

Some observations on the present state of the art of qualifying an expert are appropriate at this point. There is no question that the present emphasis is almost exclusively on examining paper credentials and relating those credentials to the specific product at issue. This practice fails to fulfill the desiderata of even the first stated criterion. The witness's capacity to undertake self-education and the extent to which he has actually done so receive almost no attention. Indeed, to the extent that the expert's self-education for particular litigation is introduced at all, it is used in a perverse manner, becoming primarily a weapon with which to discredit the expertise of the witness rather than a means for qualifying him. When a potential witness admits that he has undertaken special study in order to testify in specific litigation, he becomes fair prey for derisive cross-examination, during which the pervasiveness of his self-education is dwarfed by his admitted lack of previous experience. It is difficult to understand the enhanced credibility of experience gathered at some remote period in time. In light of today's rapidly evolving technology, the inverse relationship of credible experience to passage of time involves contorted logic.

As a practical matter, the brunt of this phenomenon is borne by plaintiff's witness. It is common knowledge that there is no open market for experts with experience in specific products. They are, by and large, in the employ of institutional defendants, if they exist at all. Plaintiffs are thus forced to seek out generalists such as consulting engineers, academicians, and technicians, whose only hope for qualification turns on this process of self-education for a particular case. To require expert testimony in order to establish a prima facie case, while at the same time permitting an attack on the witness's credibility by belittling the only method by which he can become a witness, imposes a tremendous burden on the plaintiff. There may be valid reasons to distinguish between seasoned experience and recently acquired understanding, but courts should permit this question to be raised only if demanded by the scope of the technological issue. In short, it is time for courts to recognize the realities of technological expertise and insist that the capability for and acquisition of self-education be demonstrated. Once self-education has been recognized as a legitimate basis for expert qualification, the courts have a duty to prevent its debasement by reckless cross-examination.

While no explicit criteria may be adduced for the suggested qualification procedures, incisive *voir dire* predicated upon the suggested framework should afford the court adequate bases for an informed judgment. This procedure can be more advantageously pursued in the pretrial period.

In some instances, the technical issues may be of such complexity, or the range of qualifications offered by potential witnesses so diverse, that the court may find it advantageous to enlist the aid of independent technical consultants. Those consultants could guide the court in isolating the relevant technical issues and in recognizing the general background needed to address the issues. The ultimate responsibility for judging the propriety of a witness's qualification will of course remain with the trial judge.

The very nature of the problem of qualifying potential witnesses as experts precludes a precise quantitative formulation that would permit routine application of a formal check list to the great variety of technological issues and witness credentials. A basic premise for qualification of the witness has been presented, coupled with a suggested mechanism for providing the appropriate focus for the precisely defined technological issues. Together, they provide a viable basis for the selection and qualification of technological experts in products liability litigation.