Product Liability and the Technical Expert

The quality of litigation would be improved if the role of the technical expert were properly recognized.

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The technical community today faces a serious challenge in the legal arena of product liability litigation. Hundreds of thousands of product liability cases are filed each year, each requiring technical expertise of varying degrees of complexity. Scientists and engineers are called upon to evaluate diverse products involved with injuries and to communicate their findings in an environment that often appears foreign to their own technical problem-solving processes. It is our purpose in this article first to describe the basic legal structure of a product liability case and then to evaluate the present role and performance of the technical expert. Based upon this critical evaluation, we will suggest changes both in the role and function of the technical expert and in the structure of the litigation process. These changes are designed to enhance the preparation and presentation of expert testimony to make it more responsive to technical realities and the true goals of the litigation process.

The sharp increase in product litigation has coincided with some major changes in product liability law. Traditionally, a plaintiff had only to prove that the defendant was legally negligent in either producing or designing a defective product. It had to be established that the manufacturer's conduct, which led to the creation of the defective product, was substandard; that is, that a reasonable manufacturer using prudence would have exercised a higher standard of care. Today, however, in most states the plaintiff may prevail under a "strict liability" theory.

Under strict liability the plaintiff must prove that (*1*, *2*): (i) the product was defective and unreasonably dangerous; (ii) the defect existed at the time the product left the defendant's hands; (iii) the defect caused the harm; and (iv) this harm is appropriately assignable to the identified defect.

What is an unreasonably dangerous product? A product is, after all, an object, a thing. How does it become unreasonably dangerous? Perhaps it is important to stress the obvious at this juncture. In deciding whether or not a product is or is not unreasonably dangerous the focus is on the product and not on the conduct of the manufacturer. The shift from negligence to strict liability requires, if nothing else, that the inquiry be focused on the product and the use of the product and away from what the manufacturer should or should not have done or foreseen. The finest quality control techniques extant will not absolve the manufacturer of a product from liability if, in fact, the product he has placed on the market is defective.

The jury or judge ultimately decides whether or not a product is unreasonably dangerous to a user or consumer. However, this decision should be based on an understanding of the scope of consumer expectations about a product —that is, the total environment in which the product is used.

The criteria against which the defective and unreasonably dangerous nature of any product is tested in litigation are broad and far-reaching. Wade (*2*) has provided a list of seven succinct indicia for this purpose: (i) the usefulness and desirability of the product; (ii) the availability of other and safer products to meet the same need; (iii) the likelihood of injury and its probable seriousness; (iv) the obviousness of the danger; (v) common knowledge and normal public expectation of the danger (particularly for established products); (vi) the avoidability of injury by care in use of the product (including the effect of instructions or warnings); and (vii) the ability to eliminate the danger without seriously impairing the usefulness of the product or making it unduly expensive.

While certain of these indicia may be quantifiable, with the remainder requiring subjective evaluation, the final legal decision as to whether a product is in fact defective and unreasonably dangerous is based on an amalgam of all seven. The determination of defect and unreasonable danger is in one sense subjective because each product must be viewed in the particular context of its function and use. The use of the same product in two different environments, domestic and industrial, for example, may lead to different conclusions regarding its defectiveness and unreasonable danger. Thus it is critical that the product be described comprehensively in terms of the environment in which it is used, because only then can the appropriate focus be established for application of the Wade indicia. The shift in focus away from manufacturer foreseeability to consumer expectation has enlarged the scope of the technical expertise required to make the judicial decision-making process functional.

The technical expert is uniquely qualified to extract from the complex technical facts those conclusions and opinions on which the judge or jury will base their decisions. Yet, strangely enough, the role of the technologist and the interaction of law and technology in product liability litigation have essentially been unexamined (*3*). We therefore sought to analyze directly the proper role of the expert in product litigation. To what extent do his biases and predispositions affect the outcome of the lawsuit? Do fundamental semantic barriers exist between the technologist's language and that of a court of

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law? To what extent is the expert hampered by the quality and quantity of the technical data made available to him? Is the entire litigation process indeed designed to bring forth a clear and cogent technological view of the problem which must be resolved?

To undertake this study, the four of us, two lawyers and two engineers, examined and evaluated each other's problem-solving methodologies. Using the transcripts of well-litigated product liability trials, we were able to test the validity of the product trials against the established legal criteria discussed earlier.

In our critical analysis of litigated cases, we established, with admitted subjectivity, the quality, comprehensiveness, and, to some extent, the validity of the evidence, as well as the experts' opinions. We then determined whether the evidence, including expert testimony, adequately addressed the legal criteria requisite to adjudicating issues on the proper bases.

Thus we sought to examine not only whether the technological evidence met the legal criteria realistically, but also whether the technological evaluation was consistent with the problem-solving methodology of technology. The results of our investigations indicate that many of the basic premises of litigation in the products liability area require serious reexamination.

Design and Production Defects

Product liability cases are generally characterized as either production or design defect cases. The major thrust of the strict liability development was originally aimed at production defect cases in order to help the plaintiff overcome the substantial burden of proving precisely how the defect came about in the manufacturing process and then that the defect was due to substandard conduct on the part of the defendant. Under strict liability, the plaintiff must still establish that the product containing a production defect was "unreasonably dangerous" (*4*). A product is not necessarily legally defective because it contains a flaw. Since all products are flawed at some technological level (vacancies, dislocations, and microcracks in metallic products, for example), the point at which a flaw emerges as a defect must still be decided. In order to make this decision, some judgmental standard must be utilized. It is clear to us that this standard must be based on the concept of unreasonable danger. With regard to the legal determination of a design defect—that is, one that is present in an entire product line rather than in only isolated products—there is no question that the standard of unreasonable danger determines whether a design flaw rises to the level of legal defect.

While at the two extremes of the frequency at which flaws occur the distinction between design and production defect has meaning, it must be recognized that there exists a gray area in which the distinction becomes blurred. For example, let us assume that a leaf spring of a truck is flawed by gouge marks on the surface of some of its leaves or plates. If a very small fraction of the leaf springs produced by a given manufacturer contained these gouge marks, the litigation would proceed in the context of a production defect. However, if a significant fraction of these springs, as produced, contained the gouge marks, then the litigation might be conducted on the premise of design defect. The point at which the shift was made from the former perspective to the latter would be of little consequence, as long as the concept of unreasonable danger as amplified in the Wade indicia was used as the judgmental standard of every case in strict liability.

While the test of unreasonable danger is the same for both design and production defects, the societal implications of reaching a conclusion of defect differ markedly. For example, the burden of precaution in the production defect case might be for the manufacturer to remove the few gouge-marked springs before they are sold, while the burden of precaution in the design defect case might be a substantial alteration in either the design of the spring or the manufacturing process. Hence, the conclusion of defect in a design defect case is tantamount to condemning at least a feature of every one of these products or perhaps even condemning an entire product line.

Technical Causation

We have already stated that under strict liability the plaintiff must prove that the defect in the product caused the harm. The term "technical causation" refers to a special aspect of this issue, which is addressed by the technical expert in answering the question, "Did this flaw cause failure or malfunction?" The technical causation issue often surfaces even before the issue of defect can be resolved. Technical causation is intimately tied to production defect cases, though it also may occur in cases of design defect. Given the existence of a product flaw, technical causation is proved if that flaw caused this failure or malfunction of the product. The crucial importance of technical causation is illustrated in the following case study.

A fascinating recent case (*5*) arising from a seemingly commonplace automobile accident reveals the need for a high degree of interaction between lawyers and technologists at all stages of the litigation process if that process is to be viable and responsive. Although the case was intensely litigated by both parties, the lawyers and technical experts failed to appreciate their individual and interactive roles in the litigation process. As a result, issues which should have predominated were improperly addressed and obscured by irrelevancies.

The plaintiff, a 28-year-old veteran who had just returned from Vietnam, was driving his new car (12 hours old) on a dark and winding road late at night. Suddenly the car left the road and tumbled down a 10-meter ravine, seriously injuring the driver. This car was equipped with retractable headlight covers. The thrust of the plaintiff's case was that the headlight covers closed spontaneously while he was driving, causing loss of illumination. As a result, the plaintiff was unable to negotiate a curve which he did not see and the car hurtled into the ravine.

The case was fought on the dual battlegrounds of design and production defect. The headlight closure system was the focus of both allegations. In order for this system to function, a solenoid-operated valve actuates a vacuum-controlled linkage which opens and closes the headlight covers. Current enters the solenoid and opens the valve when the lights are turned on. The open valve exposes the diaphragm chamber to a pressure differential. This pressure differential on the diaphragm actuates the linkage which transmits the force necessary to open and keep open the headlight covers. When no current flows through the solenoid, either as a result of shutting off the lights or an electrical failure, the headlight covers return to their closed position.

The plaintiff began his testimony by challenging the wisdom of the closure-system design. As the case developed, the attack on the system became three-pronged. The first attack charged that electrical actuation was overly complex and inherently less reliable than mechanical actuation. The second, that a fail-safe system should have been used whereby the headlight covers would open or remain open when an electrical failure in the cover-actuating circuit occurred. Third, that the tabs connecting the solenoid to its electrical leads were designed with a reduced area of small radius of curvature which concentrated the effects of any applied stress or subsequent deformation.

However, the production defects alleged by the plaintiff provided a more graphic display of technological altercation. An electrical continuity check performed on the crashed vehicle (after it had been in a salvage yard for some time and had been cannibalized for parts) revealed an open circuit in the solenoid valve wiring. One of the plaintiff's technical experts, from x-rays of the valve assembly, traced the open circuit to a completely cracked tab connecting the electrical lead to the solenoid. In addition, the expert discovered an external chip on the epoxy resin encapsulating all but the tip of the electrical tab; he also discovered an internal void in the resin at the juncture of the solenoid and the tab.

The plaintiff's technical experts proceeded in their investigation by examining the fracture surfaces of the tab after grinding and filing away the encapsulating epoxy resin to expose the failure, and twisting the tab segments for ease of observation. They discovered what appeared to them as solidified resin on that fracture surface of the hot-lead tab. This led them to the conclusion that the tab was partially cracked prior to being molded in liquid epoxy resin and was in that condition when sold to the veteran.

The critical question to be addressed by the plaintiffs, however, was when did the complete fracture of the tab occur? We submit that, had both the lawyers and technical experts approached this case properly, its litigation would have been directed exclusively to the origin, characteristics, and consequences of this crack. All other evidence concerning design defect, accident description, and injury to the plaintiff would have become relevant if at all, only after the origin and characteristics of the complete tab fracture were clearly addressed.

The reason for this conclusion is simple. If the tab did not fracture completely prior to the accident, then the headlights were operational and the accident occurred for reasons other than loss of illumination. If this were the case, then the plaintiff obviously could not advance on either a production- or a design-defect theory. It may well have been that this solenoid tab was truly flawed in that a substantial crack did exist prior to impact, but that would have been of no consequence if it had been determined technologically that the tab could still carry the required current through its reduced cross-sectional area. Concomitantly it might well have been possible to use simpler and safer lighting system designs, but that too would have been of no consequence if, in fact, the lighting system in the automobile had been operating prior to impact. This point was not absent in the trial as litigated; however, the presentation of evidence was such that this most significant question of technical causation, pivotal to the litigation on any premise, was dispersed and never clearly and coherently addressed in the lengthy trial. Irrelevancies dominated, and the treatment of this major technological issue was sporadic and shallow.

The original trial resulted in a verdict favoring the defense. The decision was overturned on appeal because the original trial judge had refused to instruct the jury that they could find the defendant liable on the basis of the design defects. In view of the pivotal position of the issue of technical causation in this case, however, the reversal is puzzling. If the jury did not answer affirmatively to the question of technical causation as it related to the production-defect theory of the case (Did the preexisting crack cause complete failure prior to the accident?), then any consideration of a design-defect theory is irrelevant. This case was subseqently settled out of court.

Technical Issue Obfuscation

The failure to focus on the dominant technological questions in product liability litigation is not peculiar to this case. We have found that focusing on irrelevant issues is a rather common phenomenon in product litigation. In our opinion, this is because the legal and technical experts fail to understand each other's goals, methodologies, and limitations.

The problem arises at the very inception of the relationship between the lawyer and the technical expert. Fundamentally, the lawyer views himself as the primary director of the litigation with the technologist relegated to a secondary service position. After some initial exploration with the technologist, the lawyer develops his theory of the case and the technologist is then asked to fill in the technological gaps in the lawyer's theory. Rarely is the technologist educated to the legal criteria of product liability prior to his being channeled into his secondary gap-filling role. Often he is not made aware of the possibility of obtaining more product-related information via legal discovery procedures. Time constraints imposed by the expert's late entry into the case often eliminate the possibility of adequate investigation. The analogy to the blind leading the blind is not inappropriate. What is lost in this traditional lawyer-expert relationship is the potential talent of the expert in helping to frame the relevant and often clear-cut technological issues germane to the case at hand. This situation also contributes to the disenchantment of the technological community with the judicial process. The expert who has been prepared for a narrow role and subsequently finds himself under brutal cross-examination on a global front for which he is unprepared finds the adversary setting unresponsive to the realistic presentation of technological evaluations and personally degrading as well.

The fault lies not in the adversary system per se, however, but in the inadequate relationship between the technologist and the lawyer in formulating the case. If the technologist were to become a resource rather than a tool, a coequal partner rather than a gap-filler in the structuring of the litigation, then it would be possible to focus attention on the more appropriate technical issues.

It is clear to us that if, in the case of the retractable headlight covers, the technologist had played a different role in helping to frame the theory of the defective solenoid tab, the case would not have proceeded for days on end with so much attention being paid to tangential or, at very best, secondary technical issues while the question of technical causation was ignored. And if, in fact, it was the desire of the attorneys to try the case by presenting an overall aura of defect unrelated to technical causation, then the technical experts should have chafed at being relegated to a role of technical obfuscation. The goal of our study is, in part, to implement those changes in the litigation process which would make it more responsive to technological realities. But we consider that it is equally important to challenge the technological community to insist on an active and creative role both prior to and during litigation.

Evidence Preservation and Control

The unresponsiveness of the litigation process to technological realities manifests itself again in the cavalier fashion in which physical evidence is gathered, controlled, tested, and preserved. The abuses often start immediately after the injury-producing event and may continue sometimes to the very end of the trial. Setting aside for the moment the possible distortion of the physical evidence in the accident itself, we maintain that the benign neglect of physical evidence is staggering. Crucial evidence, such as fracture surfaces, is left to deteriorate in junk yards for periods up to several months. When finally sought out by one party or the other, destructive methods are frequently used to gather selected parts. Very often some other relevant parts are lost or destroyed. Still further degradation may occur as a result of inadequate preservation and storage methods. The selection, sequencing, and execution of unilateral testing programs often denies the opposing party an equal opportunity to evaluate the physical evidence. As a result of the abuses of the physical evidence, the litigation process, complex enough with adequate physical evidence, is reduced to a sophisticated guessing game.

The case of the retractable headlight covers again demonstrates the need for responsible gathering, preserving, testing, and controlling of physical evidence. A major portion of the trial was spent in determining whether the solenoid tab was actually cracked while the car was being cannibalized or while tests were being performed after the car had come to rest in a junk yard. Thus the issue of failure prior to impact or during the impact was now unnecessarily complicated by introducing a third feasible theory of tab failure: final fracture due to cannibalization or due to improper testing by the experts. This problem is so crucial that it must eventually be remedied by removing the responsibility for the physical evidence from the hands of the litigants and placing it in the domain of the courts or other institutions. Until better evidence control is implemented, the technologist is peculiarly equipped to exercise evidentiary responsibility. Again the technologist must see his role within the context of the adversarial system, not within the confines of his laboratory. In the solenoid-tab case, for example, plaintiff's experts should have realized that their nonstandard and destructive testing methods would raise the possibility of questions regarding changes in the state of the evidence as a result of testing. An active attempt on the plaintiff's part to arrange for joint testing would have removed this hotly contested issue from litigation.

The Technical Expert's Opinion

The product liability litigation process challenges the integrity of the technological community in several additional ways. The culmination of the expert's testimony is his opinion on the issues of defect, or causation, or both. It is the advocate's role to have that opinion delivered with as high a degree of certainty as he can possibly elicit. The technologist, however, is torn between the advocate's desire for increased certitude and his own technological assessment of the limitations inherent in formulating his opinion. These limitations come from various sources: the state of the physical evidence; the extent, adequacy, and reliability of data from testing programs; the levels of inherent uncertainty or error in the model currently available in his discipline; and the reliability of any eyewitness testimony. Added to the technologist's dilemma is the crucial factor of assigning relative values to each contributing factor in order to arrive at his final opinion.

The tension that is experienced by any technical expert who testifies in a product liability trial is both unhealthy and unnecessary to the litigation process. That the expert must express his opinion within the structure of the adversary system, and must often advocate a conclusion that is at variance with the conclusion of a colleague on the opposing side, cannot be denied. Some degree of stress is an integral part of decision-making when different conclusions based on different assessments of the same data can be reached; and technologists are trained to deal with such dilemmas. What must be changed is the lack of communication between technical experts and the legal community. The conclusions reached by the technologist after he has conducted his investigations depend upon the very sensitive balancing and weighing of probabilities. In view of this inherent uncertainty, declarations of either 0 or 100 percent probability are ludicrous and certainly convey no useful information to the jury. Indeed, juries faced with diametrically opposed opinions may formulate their own theory of the case; in effect stating to the experts, a pox on both your houses. If expert testimony is to be of value in product litigation, the technical reasoning process and the assignment of realistic probabilities must clearly be communicated to the jury.

Returning once again to the case of the retractable headlight covers, we found that the expert testimony on the part of both the plaintiff and the defendant was extremely polarized. The experts on both sides were completely dogmatic about their respective positions. Their testimony did not reflect a delicate balancing and evaluation of competing alternatives in a case which, in our opinion, was fraught with technological uncertainty. We do not mean to suggest that legitimate opinions could not be reached on either side; we only mean that these opinions could not have legitimately been expressed as absolute. Some may argue that it is the function of cross-examination to humble the expert and bring his opinion down to more realistic levels of certitude. In our opinion this is a myth. Cross-examination can only destroy; it cannot create. While cross-examination of the experts in the solenoid valve case may have partially discredited the expert's opinion, it did not serve as a creative tool to present to the jury a balanced view of the question of technical causation. For the technical evidence to be dealt with realistically, the expert must perform his delicate balancing of the evidence well in advance of the trial and must explain his methodology in direct testimony, not by a process of backing down from absolutism during cross-examination. This process would not only encourage honest and forthright technical presentations but would impress on the expert the desirability of performing additional physical tests, examinations, and testing which would demonstrate the mode of final tab failure. Had the experts in the solenoid valve case presented their technological evaluations in terms of realistic probabilities, they would of necessity have demonstrated the need for additional and more detailed examination of the physical evidence and for reconstruction of the mode of the final tab failure, the event that was crucial to the demonstration of technical causation. Additional tests to determine the size of the crack in the tab at the time of sale, as well as tests which would reveal the final failure of cracked tabs under operating conditions, were both feasible and desirable in the evaluation of such an inherently close technical question.

The Seriated Trial

We have emphasized the responsibility of the expert to assess realistically the physical evidence that he is asked to examine, and to communicate effectively the realities of his technological investigation. For the technologist to accomplish this, however, the litigation process in product liability trials must be altered so that this new role of the technical expert is encouraged. It should be possible to structure a product trial so that the questions related to product integrity and technical causation are treated apart from the other issues of liability. In cases where these questions could be considered and resolved by the jury independent of issues of injury and damages, an altered trial format would isolate and clarify these issues. Specifically, a trial format which we have termed "seriated" would have the jury answer the questions of technical causation and product defect before the specific injury and its consequences are introduced (*6*). This is but one example of how the legal community might be brought to respond to technological realities.

Conclusion

The refinement of the product liability litigation process requires a continuing substantive dialogue between the legal and technical communities. The common problem-solving orientation of the two disciplines bodes well for such interaction. We have shared in the exciting beginnings of this legal-technical interaction (*7*) and hope that in the field of product liability such joint efforts will lead to a more sophisticated and technologically sound litigation process, one in which the technologist can be true to himself while operating within a strong and responsive adversary system.

References and Notes

1. W. L. Prosser, *The Law of Torts* (Foundation Press, Mineola, N.Y., ed. 4, 1971).
2. J. W. Wade, *Southwest Law J.* **12**, 5 (1965).
3. While there is extensive literature dealing with various aspects of the law-technology interface, studies have not been focused on the establishment of the defect-causation link in strict liability litigations.
4. We maintain that the standards for strict liability recently set forth by the California and New Jersey courts in Cronin *v.* J. B. E. Olson Corp., 20 California Appellate Court 2d, 33, 501 Pacific 2nd 1153, 104 *California Reporter* 433 (1972) and Glass *v.* Ford Motor Co., No. L-17576-70 (New Jersey Superior Court, 3 May 1973) are seriously off the mark. These courts permitted the establishment of defect without reference to the "unreasonable danger" standard. However, while discarding the "unreasonable danger" standard, the California Supreme Court in the Cronin case did recognize that defect cannot be established without reference to some given standard.
5. Chestnut *v.* Ford, U.S. District Court for West Virginia, Docket No. 5778-R.
6. A. S. Weinstein, A. D. Twerski, H. R. Piehler, W. A. Donaher, *Duquesne Law Rev.* **12**, 425 (1974).
7. We have met with the Professional Engineers in Private Practice and drafted a document which addresses the procedures for qualifying an expert. We are also engaged in the activities of the newly created American Society for Testing and Materials Committee E-40, "Technical Aspects of Products Liability Litigation."

8. This research was supported by the National Science Foundation's Division of Exploratory Research in its program Research Applied to National Needs (RANN).

Green Revolution (I): A Just Technology, Often Unjust in Use

If the poor countries of the world are to grow enough to feed their swelling populations, peasant farmers must somehow produce more food from lands whose yields have remained static for centuries. The Green Revolution, a Western-style package of agricultural practices designed to bring about such a transformation, succeeded beyond expectation when introduced into India and Pakistan in 1967. But since its heady early progress, the revolution has run into technical problems and into sometimes bitter criticism that, far from breaking the chains of rural poverty, it has left poor farmers worse off than before. The latest blow is the energy crisis which has raised, sometimes beyond reach, the prices of the fertilizer, fuel, and pesticides on which the new techniques depend for much of their superiority.

A major impediment to assessing the present state of the Green Revolution is the rhetoric that has accreted round it. Academic writers often attribute the overblown slogans to journalists. In fact they were helped into currency by the foundations and aid organizations trying to promote the new techniques. The term "Green Revolution" was coined by William S. Gaud, a former administrator of the Agency for International Development (AID). Before the term became unfashionable, the marvels* of "miracle wheat" were loudly proclaimed by the Rockefeller Foundation which, together with the Ford Foundation, supported the early work on wheat in Mexico and on rice in the Philippines.

The new agricultural techniques were oversold and, in general, overbought, by governments as well as journalists. Until the bad harvests of 1972, countries such as India and the Philippines believed they would soon attain self-sufficiency in food production, and economists fretted that exportable surpluses would send grain prices plummeting. These hopes were excessive, and the Green Revolution has failed to live up to them. After the initial overselling, the counter-reaction has been equally extreme. "The Green Revolution is a hoax," states Marvin

* Under the heading "Miracle in Wheat," for example, a Rockefeller Foundation report of 1969 mentions that introduction of the new wheat varieties into India "has increased yields up to sevenfold." The average yield of Green Revolution strains in India in 1968/69 was 3.49 times that of traditional varieties.