Forensic Engineering Information Services

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THE AUTHOR WRITES FROM the perspective of an engineering reference librarian for Triodyne Inc. Consulting Engineers, a firm specializing in forensic engineering and safety research. The style of reference service offered typifies trends in many special libraries, but the employer operates in a nontraditional segment of the industry—engineering consulting. Forensic engineering is the application of accepted engineering practices and principles for discussion, debate or for legal purposes.[1] This discipline has grown apace with the products liability litigation movement of the past two decades. Information services in forensic engineering have rigorous and well-recognized requirements, including, for example, state-of-the-art documentation. An attempt will be made in this paper to summarize the historical development of product liability laws, to specify problems in searching the scientific and technical literature for information to be used in product liability lawsuits, and to review the activities of Triodyne Inc.

Product Liability Litigation

Since the early 1960s, there has been an astonishing increase each year in the number of product liability lawsuits. Twenty-five years ago, there were less than 5000 a year[2]; today, the current level is more than 1 million. In Cook County (Illinois) alone, total judgments increased from less than $4 million between 1960 and 1964 to $33 million from 1975 to 1979.[3]

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Some would say that if a product can be manipulated, operated or played with; ridden, driven, climbed on, walked on or slid on; slept on, in or with; eaten, administered, prescribed or worn, it is subject to defect and, therefore, subject to a product liability lawsuit. Others would say that is not such an exaggeration; rather, it is perilously close to truth.

Why this dramatic rise in number of liability suits which some might call epidemic? The answer to this lies in the evolution and development of liability laws and legislation predicated on the interplay of many different disciplines and activities. These include design engineering, manufacturing, processing, quality control, marketing, legal and judicial principles, insurance laws and practices, and, of course, increased safety awareness and heightened expectations of consumers.

What is product liability? It has different meanings depending on the context in which it is used. In legal terms, product liability describes an action, such as a lawsuit, in which an injured party (the plaintiff) seeks to recover damages for personal injury or loss of property from a seller, a manufacturer, or an insurance company (the defendants) when it is alleged that the injury or loss resulted from a defective product. From a technical viewpoint, product liability is thought of as the responsibility of a manufacturer for the proper, safe, and reliable performance of his product. When manufacturers produce goods with safeguards against predictable defects, deficiencies, abuse, or misuse, product liability should be minimized. On the other hand, and even in the best of worlds and times, consumers will abuse or misuse a product despite all cautionary measures, and products do break down, resulting in an increase in the number of product liability suits.[4]

Legal Traditions Relating to Product Liability

To bring the picture into focus, we need to trace the history of manufacturer's product liability, a history reflecting the changing attitudes of the market. The concept probably extends as far back in ages past when the first clansman fashioned a pointed stick for a fellow clansman to use for spearing fish in the local stream. The fisherman found the stick to be defective when it broke on the second attempt to spear a fish, thus depriving the clan of its next meal. It is doubtful that any legal battle was fought over the problem; however, at the next gathering of the clan, the group may have had to wrestle with the issue of whether a defective spear made from wood of questionable quality, resulting in the loss of a meal, was of such consequence as to require banishment from the clan of the poor fellow who made it.

In the Middle Ages in England, probably the oldest and best known rule of the marketplace was expressed by the Latin maxim "caveat emptor" or "let the buyer beware." In those days, the bootmaker or harness maker dealt face-to-face with customers living within a day's walk of his place of business and who also were part of the local scene on market day, in church or at festival time.[5]

With the advent of the Industrial Revolution, more and varied products were produced in factories in one area, for sale in yet another area. New industries were born; changing methods of manufacturing called for new marketing techniques. Increased production of goods resulted in a corresponding increase in consumption. All these factors necessarily complicated the issue regarding the responsibility of the manufacturer for his product and the responsibility of the retailer or seller for goods sold in the marketplace.

At that time, two points of product liability were recognized: (1) the relationship between the parties entering a contract, or "privity of contract," and (2) common-law decisions based on negligence.[6] This was known as the English common law which formed the basis of the law administered in the United States. This law held that a manufacturer was liable in damages only if he was proved negligent in the manufacture of his product. And only those who had contracted directly with the manufacturer in the purchase of the product could qualify as the plaintiff. This was known as "privity of contract" and meant that Consumer *A* could not sue Manufacturer *C* for damages unless the consumer had dealt directly with the manufacturer and not with Retailer *B*.[7]

This is best illustrated by the famous case of *Winterbottom v. Wright*.[8] Here the Postmaster General of England had purchased a coach which overturned on one of its appointed rounds, injuring the driver, Mr. Winterbottom. It was found that the coach had a defective wheel. There being no privity of contract between Mr. Winterbottom and the manufacturer (Wright), the case was dismissed. The rule of privity of contract remained in effect with few exceptions until 1916.

In that year, *MacPherson v. Buick Motor Company*, a landmark case, was tried in the United States.[9] Again, a defective wheel caused the collapse of the automobile, injuring the driver and passengers. None of these people had a contractual relationship with the Buick Motor Company. The judge ruled, however, that if a product when defective was capable of causing injury, it was an inherently dangerous product. This ruling had the effect of completely eliminating privity of contract as an element of proof in a negligence case, thus expanding the class of those protected to include virtually anyone injured by the product, whether a direct user or not.[10]

This resulted in a major shift away from the traditional concept of common-law liability for manufacturer's negligence to one of holding the manufacturer liable in negligence to an ultimate third party, the consumer, even without privity of contract. The doctrine of "caveat emptor" which had stood substantially unchanged for hundreds of years now gave way to "caveat venditor" or "let the seller beware."

Consumers and Product Liability

Over time, court decisions were built upon this idea of multiple liability: the manufacturer of the product, the component manufacturer, and the final assembler as well. On the flip side, the protected group was expanded to include virtually anyone injured by a product, even if the injured party was not a direct user; e.g., an unfortunate bystander.

From that jumping-off point, the pendulum began to swing strongly in favor of the consumer, with the courts favoring more and more strict liability. The burden of defense shifted from the plaintiff, or injured party, to the manufacturer, the defendant. Before this shift, the plaintiff had only to prove negligence on the part of the manufacturer to collect and to prove that the product was not manufactured according to accepted standards; and that its design was defective or not in line with industry practice. If, for example, a machine had a number of sharp, whirling blades, it was assumed that a reasonably prudent person would not reach into those blades. Anyone who did was not likely to collect in a lawsuit.[11]

Under strict liability, the plaintiff need only prove that the product was unreasonably dangerous or defective, that the defect existed when the product left the control of the manufacturer, and that harm or damage was caused by the defect.

Manufacturers now had to second guess not only how the consumer would use his product, but even how he might misuse it. For example, a woman collected a large settlement from an oven manufacturer when she used an open oven door as a step stool while changing a light bulb. The door hinge broke, the woman fell and was injured, and the court ruled that the manufacturer should have foreseen this use.[12]

Public attitude toward product quality and reliability began to change. Mass production tended to reduce price, increase quantity and, frequently, affect quality. Feelings of dissatisfaction by the consumer were picked up by public crusaders and politicians. City, state and the federal government were pressured to enact laws to protect the "helpless" consumer. Publicity was given to large product liability suit settlements, and crusaders such as Ralph Nader attracted a following.[13]

The manufacturer, and those involved in the chain of merchandising, quickly came to be perceived as the uncaring bad guys accused of developing products of poor design and shoddy workmanship and products lacking in quality control. Further the manufacturer was perceived as best able to pay for damages, the one with the deepest pocket whatever the loss. After all, there is no point suing someone with only twenty-five cents in his pocket.

The uproar eventually caused the creation of a National Commision on Product Safety, followed by the Consumer Product Safety Act of 1972. By the 1960s, the times were right for a surge to begin in the number of product liability suits: heightened public awareness to the changing laws favoring the plaintiff's side, publicity given to settlements in five and six figures, and a plethora of attorneys eager to acquire the fruits of litigation. By accepting clients on a contingency basis, attorneys could collect 30-40 percent of all awards made—quite a tidy sum considering some of the multimillion-dollar settlements made in recent years.

Expert Testimony and Product Liability

As lawsuits proliferated, experts whose testimony could make or break a case in court emerged as a major part of the American litigation scene. Because of the mechanical complexities of products and processes, the chemistry of substances and materials, the geometry of ricocheting particles, some technical point is usually a key issue in a product liability suit. Doctors, engineers, economists, firearms and explosives experts, as well as persons specializing in street-gang subculture, food sensory evaluation, tree failures, bite-mark identification, animal and human psychology, and in forensic engineering were sought after to supply expert testimony.

The *Federal Rules of Evidence,* Rule 702, states that: "If scientific, technical or other specialized knowledge will assist (the courts) to understand the evidence or to determine a fact in issue,...an expert by knowledge, skill, experience, training, or education may testify...in the form of an opinion or otherwise."[14] Believability is primary to the case. An outside expert is more apt to be seen by judge and jury as having no bias to the case.

In the course of a trial, the expert may be asked to determine how a product failed and why. This requires an analytical evaluation of the product and may also require laboratory testing (e.g., failure of a jam nut to hold at high altitude). He may be called on to determine if a product was designed and manufactured according to accepted industry standards (e.g., should the product have been welded rather than bolted). He may be used for his knowledge of equipment and repair costs. He may be asked to reconstruct the probable events of an accident and their significance in the absence of witnesses, or when all equipment and products involved were destroyed (e.g., explosions, fires, vehicle accidents). Expert opinions of risk call for knowledge of both design and industry practice. For example, did the design and placement of a motorcycle kickstand contribute to an accident when the kickstand failed to retract upon contact with the ground while traveling at 45 mph and rounding a curve? The expert must be able to analyze the product or event to determine if some element in any way helped create a potentially dangerous situation or was directly related to a failure.

The expert may have only a bit part to play in the courtroom drama or he may have the starring role in the outcome of a multimillion-dollar lawsuit. His testimony will be based not only on his own professional knowledge and personal skill, but also will have been supported by the work of his staff of engineers, graphic artists, model builders, laboratory technicians, and librarians.

This support may take the form, for example, of field reports of the accident site; two-dimensional drawings of two-hand controls for machine tools; a scale model of a truck cab demonstrating positions of side- and rear-view mirrors and their field of view; a scale model of a vehicle accident site showing position of guard rails, bridge abutments, shoulders, ditches, etc. in relation to the roadway, and the probable trajectory of the vehicle as it left the highway; laboratory test results of impact strength of material; and documentation showing which, if any, industry or federal standards were in effect at the time the product was manufactured.

It was the increasing need for just such assistance and professional skills that gave birth to Triodyne Inc. Consulting Engineers.

Gathering the Evidence—Forensic Engineering

Triodyne Inc. is a firm which specializes in forensic engineering and the safety of engineering systems and mechanical devices. Founded in 1969 by two mechanical engineering professors, the firm now operates in three locations with corporate offices and laboratories for model building, photography and vehicle analysis. Its clients are trial lawyers, manufacturers, injured parties, insurance companies, and others who need technical assistance in trial preparation and in expert testimony. These activities may be grouped under the rubric of forensic engineering, a relatively new and multidisciplinary profession in which technology interfaces with the law. In addition to its work in forensic engineering, Triodyne is retained by insurance companies and manufacturers to conduct research and development in other areas of engineering; however, the information services for such areas are not as dependent on library research as is in the area of forensic engineering.

The staff is composed of engineers, scientists, graphic artists, librarians, and technicians engaged in product safety review, accident reconstruction, design analysis, fire investigation, model building, mechanical systems and components evaluation, performance testing, the reduction of information to graphic form, and literature research and state-of-the-art documentation.

Briefly, here is what happens in a typical product liability case handled by Triodyne staff. After an accident occurs and a client/attorney retains Triodyne to work on behalf of either a plaintiff or a defendant, a project engineer is assigned to supervise the firm's effort for that client. The significant aspects of the case and the allegations made by the opposing side are outlined by the client. This is a critical time in the development of the case, for it is here that the details of the accident must be spelled out in order for the engineer to develop a strategy for investigating the case.

The first step in the investigation is an inspection of the accident site and the product or machinery (called an artifact) allegedly involved in the accident. Photographs are taken of every possible angle or operation and of every component part of the artifact that might have bearing on the case. Inspection notes and photographs are converted into a field report which becomes part of the official record of the firm's involvement in the case. At this point a literature search may be requested.

The type and amount of literature required for a case may vary, but generally the following are needed: standards and codes in force at the time the artifact was manufactured, literature which documents industry practices prevailing at the time of manufacture, reports on modifications in the artifact or manufacturing process from the date of manufacture to the date of the accident, manufacturers' catalogs and operating manuals illustrating or defining comparable products on the market at the time of manufacture, reports of safety problems encountered in the use of the product or comparable products, and accident statistics for the product or process in question.[15]

Role of the Information Center

The purpose of Triodyne's Information Center is to fill these needs. Its collection is similar to that of other engineering or special libraries in that it includes books, journals, indexes in technology, standards, manufacturers' catalogs, automotive service and operating manuals, technical reports, pamphlets, and blueprints. Triodyne's dissimilarity occurs in the quantity of retrospective material held and continually sought in order to access the state-of-the-art for any durable product manufactured anywhere from ten to fifty years ago. Where most libraries tend to discard superseded titles with some regularity, the information center's staff combs the "give-away lists" and badgers colleagues to "throw it our way." Their junk becomes our gold.

Early editions, for example, from the 1940s and 1950s of the National Safety Council's *Accident Prevention Manual for Industrial Operations* are highly prized, as are handbooks of the Society of Automotive Engineers (SAE) and issues dating from the 1920s of *Agricultural Engineering* of the American Society of Agricultural Engineers (ASAE). These titles give details of the technology of industrial operations of their day, and they list standards and recommend practices for automotive equipment and farm machinery of the past.

Recently, we were asked to document the historical development of agricultural tractor power-take-off (pto) shafts, their drivelines, and the guarding or shielding of these moving parts. A farmer became entangled in the pto-driveline of his tractor and brought suit against a tractor manufacturer. The tractor in question dated from the 1940s and had been modified over the years to accommodate more sophisticated tractor-drawn and tractor-powered implements. In order to document the progressive changes and improvements made by the industry on pto's and component connections, the information center searched its retrospective holdings of standards and recommended practices, made numerous telephone calls and wrote to standards-writing organizations, and traveled frequently to the John Crerar Library to pore through its rich holdings of retrospective standards from ASAE and SAE.

The earliest standard for pto's dated from 1917, with revisions beginning in the 1920s and continuing into the 1980s. Since the advent of pto's influenced development of additional components on tractors and tractor-drawn implements, succeeding standards and recommended practices were written. And then the fun began! Terminology was neither standardized nor well defined in the 1920s—Who had time for that?—as mechanized farming was still in its infancy. Titles of standards changed to include broader applications for pto's, then later changed again as tractor power stabilized at 540 rpm and 1000 rpm, with further title and content changes being made as the safe operation of farm machinery became more of an issue in the industry. The genealogical record of the ancestry of the wives of Henry VIII and their progeny just might have been more complex; however, verifying that all pertinent standards with their revisions were at hand or on order, and designing a matrix to illustrate the scope and revisions of these standards was certainly more critical to Triodyne than who gets to be queen.

The literature-search process is greatly affected by the fact that information is often needed quickly, with results preferred yesterday. Trials are not postponed in deference to information or document-retrieval problems. As trial testimony progresses and issues surface which could not have been anticipated, the expert may telephone the information center during court recess for information he suspects exists and is needed.

Recently, a call came in where the courtroom expert wanted to know whether mechanical engineers were involved in the development of city building codes—codes thought to be in the purview only of civil engineers. While the expert waited on the line, a librarian verified in the building codes of a major city that mechanical engineers were indeed utilized in the writing of that city's codes. As a result, the case settled immediately after recess.

It is the practice of the information center to develop a bibliography of pertinent documents for each case and to record and file these documents by case name as well as by subject (e.g., cranes, hedge trimmers, jon boats, log splitters, hot-air balloons, magnetic switches, gym mats, autoclaves, etc.) or by issue (e.g., guarding by location, visual depth-perception, stairway lighting, force required to cause injury to the human eye, hand-grip reflex action, head room in trucks, physical properties of soils, safety requirements for purging tanks before welding, speed of running man, etc.).

As similar cases are worked on, recourse to previously gathered documentation becomes a blessed time-saver even should there be slight variations in the issue from one case to another. In many instances, bound volumes of previously gathered documents with their accompanying bibliographies are prepared, recorded and filed for quick retrieval should such material be needed again on similar cases. Some searches are never ending. We are still looking for literature discussing the motor vehicle's "firewall," now breached in several places to accommodate instrument-panel connections to engine components.

Terminology is an ever-present problem, as is true with any profession having its own peculiar jargon and technical terms. A library can hold the world's total of dictionaries—mono-, bi-, trilingual—and yet be left without a proper definition of, say, a *pintle hook* or *safety.* Further muddying of the waters is in the transfer of information from client to engineer to librarian. Some mistakes are only amusing, while others are of such seriousness as to send the expert out to trial with an industry standard for a "manlift" when what he really needed was the standard for "elevating and rotating work platforms." These are two quite different devices. The first, *manlift,* is used in parking garages, for example, to lift a car jockey quickly to an upper level to retrieve a car, while the second device, *an elevating and rotating work platform,* is usually a truck-mounted, articulating boom lift with a basket from which a tree trimmer or a utility company employee can operate at above-ground levels.

Malapropisms creep into the information exchange to add levity to an otherwise intense, often frantic work schedule. A new member of the library staff took a telephone request for information on "anti-tube-locking devices for trains." Well, let's see: "anti-" meaning against or hostile to, "tube" as in toothpaste?, "locking" as in the act of securing something, and "trains"...no problem. The staff wizard, who has yet to forget a case name or issue involved, puzzled over why anyone was spending time on a toothpaste tube search and revealed that the multi-word term was in reality "anti-two-blocking devices on cranes."

To support the very specialized nature of the company's interest, the relation to its information requirements, and the time frame in which information must be retrieved, access via computer terminals to OCLC, DIALOG and SDC is available. Although these databases are essential to our operation, they have not proved as successful as was anticipated, largely because of our need to zero-in on unindexed minutia, and also because the vintage of some artifacts is such as to preclude their inclusion in machine-readable databases; e.g., World War II steel, a 1925 drilling machine, or a 1938 furnace.

Further the multidisciplinary nature of the literature in safety and forensic engineering requires searching across a broad band of print and nonprint sources. A case in point is with the literature in human factors engineering, or ergonomics—a field of study which emerged as a distinct discipline following World War II. It is a fruit basket of interacting disciplines in the behavioral and biological sciences, mathematics, statistics, and anthropology; and with the professions of design engineering and architecture.[16] It is the study and process of designing products we use, how they are used or misused, and the environment in which we work. Its literature is yet to be sufficiently indexed to enable an online search to come up with, for example, the torque strength of the hand of a six-year-old Caucasian boy, or the reach distance of a supine fiftieth-percentile forty-year-old woman.

Conclusion

The thrust of the company's interests, the uniqueness of the subject matter, and the scope of the information-retrieval process are legion and vastly interesting. We cannot underestimate the value of cooperative arrangements with such systems and networks as the North Suburban (Illinois) Library System and ILLINET, whose services extend our library's holdings. Nor can we praise loudly enough our colleagues in libraries all over the country whose help via an "underground railroad" system of assistance from one possible source for information to another is valued second only to our holding the published document on the needed subject at the moment. In interacting with engineers and in searching the literature, it helps to have some sense of mechanics and be able to visualize how things work or do not work. A bachelor's degree in general engineering would, perhaps, have been more useful than one in music; however, this writer had no trouble driving the tractor-drawn corn picker from one end of the parking lot to the other!

References

1. *McGraw-Hill Dictionary of Scientific and Technical Terms,* s.v. "forensic engineering."

2. Milhalasky, John. "Product Liability: Status and Future" (ASME Publication No. 74-WA/SAF-2). New York: American Society of Mechanical Engineers, 1974.

3. Tarnoff, Stephan. "Product Liability, Malpractice Cases Jump: Study." *Business Insurance* 16(22 March 1982):60-61.

4. Colangelo, Vito J., and Thornton, Peter A. *Engineering Aspects of Product Liability.* Metals Park, Ohio: American Society for Metals, 1981.

5. Jacobs, Wyatt. "Products-Liability Suits and the Engineer." *Mechanical Engineering* 94(Nov. 1972):12-19.

6. Colangelo, and Thornton. *Engineering Aspects of Product Liability.*

7. Aronson, Robert B. "The Expert Witness; Why He is Needed." *Machine Design* 49(7 July 1977):64-67.

8. Winterbottom *v.* Wright. 152 Eng. Rep. 402 (1842).

9. MacPherson *v.* Buick Motor Company, 217 N.Y. 382, 111 N.E. 2d 1050 (1916).

10. Gebhardt, Wilson A. "Product Liability—Let the Sellers' Engineers Beware." Honorary Engineering Lecture. University Park: Pennsylvania State University, 18 Feb. 1975.

11. Ramm, Edmund C. "The Costly Misuse of Farm Machinery." In *Engineering a Safer Food Machine*. St. Joseph, Mich.: American Society of Agricultural Engineers, 1980.

12. Colangelo, and Thornton. *Engineering Aspects of Product Liability*.

13. Milhalasky, "Product Liability."

14. Redden, Kenneth R., and Saltzburg, Stephen A. *Federal Rules of Evidence Manual*. Charlottesville, Va.: Michie Company, 1975, p. 225.

15. Hamilton, Beth A. "Reinventing the Wheel: Information Services in Forensic Engineering." In *Issues and Involvement*, compiled by Pamela Jobin and Marcy Murphy, pp. 39-48. New York: Special Libraries Association, 1983.

16. McCormick, Ernest J., and Sanders, Mark S. *Human Factors in Engineering and Design*, 5th ed. New York: McGraw-Hill, 1982.