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CONSUMER PRODUCT SAFETY

A SYSTEMS PROBLEM

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Dr. Carl C. Clark
Staff Consultant
on
Product Safety

National Bureau of Standards

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System Safety Conference**

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Carl C. Clark
Staff Consultant on Product Safety
Product Evaluation Technology Division
National Bureau of Standards
Washington, D.C. 20234
301-921-2967

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ABSTRACT

The manufacturer, tester, retailer, consumer, repairer, disposer, trade and professional associations, national and international standards bodies, and governments in several roles are all involved in consumer product safety. A preliminary analysis, drawing on system safety techniques, will be utilized to distinguish the inter-relations of these many groups and the responsibilities that they are or could take for product safety, including the "slow accident" hazards as well as the more commonly discussed "fast accident" hazards. The importance of interactive computer-aided information flow among these groups will be particularly stressed.

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This document represents the views of the author, but not necessarily those of the National Bureau of Standards administration.

INTRODUCTION

The simplistic pictures of life's problems confound efforts to deal with the solutions, in their intricate complexities. Some of us may be attracted to the slogan solutions - "accidents are caused by the nut behind the wheel" - but study soon shows that human events, such as an injury while using a consumer product, cannot be said to have one cause, one fault, one solution. It obscures understanding and yields limited improvement to look for and try to act on the cause of an accident. Human events have thousands of "causes" or antecedent events, many of which might be modified to increase safety.

This is "coal to New" system of safety engineers in their own specialties - particularly space safety or military systems safety. But we are just learning to apply these techniques to consumer product safety. How many aerospace systems safety engineers apply these techniques in their own homes? Instead of waling junior right away for leaving books on the stairs that pa tripped over, how many of us analyse the many changes that would have reduced the chances of this event - improved lighting, wider stairs, tables near the bottom and top of the stairs for holding things we wish to later take up or down, less to drink before dinner, less shouting at the family and stomping on the stairs to show who's boss, etc. - before waling junior?

Clearly, the systems effectiveness and systems safety techniques of analyses of reliability, maintainability, operability, supportability (logistics), compatibility, design simplicity, human factors, dependability, availability, hazards, failures, fault trees, environment effects, systems safety plans, safety documentation and communication, safety audit procedures, etc., could be utilized to increase the safety of consumer products and their use.

For space and military products, the government has the responsibility and the capability through contract requirements and payments to minimize the costs of product purchase and product use, including the human and dollar costs of safety failures. For consumer products, the picture is less clear as to who is responsible for safety, and the capabilities of the individual product purchaser, the

consumer, are far less than the government to specify or even to find out the level of safety or other use costs of the products he buys. The cost of safety features is localized with the price of the product; the savings of safety are very distributed. But consumers, acting as voters, are expressing a group interest through legislation for more government concern with increasing the safety of consumer products.

THE SAFETY INTERFACES

Figure 1 diagrams some of the more important safety interfaces. Traditionally, the consumer exchanges money with the manufacturer for products, and has the responsibility (caveat emptor - buyer beware) to select the products that serve his needs, using injuries as experience in judging safety. As the market has proliferated so that experience with particular products is more diffuse, and as products have become more complex, so that their hazards are largely hidden, governments, particularly through judicial powers and tort law development, have held the manufacturer increasingly responsible for his product (caveat vendor - seller beware). As Morris Kaplan put it, (1)

"The consumer has a lot of catching up to do. Much has happened between the hoe and the mechanical cultivator, between homespun and polyester knits, between illustrated books and color television. By the time he learns about a gas or electric stove, there's a radar oven. After he learns the difference between real and artificial silk, he is confronted with acetate, nylon, polyester, acrylics."

The manufacturer gives an implied warranty for his product, and may give an express warranty as well, but it is noted that his responsibility for his product is far from complete. His express warranty may cover only a few percent of the design use life of the product, and products liability insurance and case settlement payments of 0.05% of sales are not unusual. (2)

Looking again at Figure 1, it is the government far more than the individual consumer that has utilized injury information. Through legislation and regulation (or executive law), the government requires the manufacturer to consider certain aspects of consumer product

safety (cave legem - beware of the law, an expression I suggest). However, the government has had only a moderate impact on consumer product safety in any given decade - although the combined effects are very important, and total hazards perhaps particularly in food and drugs might be far worse without any government action. Hence, the practice of the marketplace continues to be caveat emptor - buyer beware - however much we talk about products liability, class action, self-regulation, and government regulation trends.

It is the consumer who pays - is handed the responsibility - for most (I suggest about 90%) (3) of the product performance failures, and most (I suggest 50%) of the costs of injuries involving the products he buys. (My rough working estimate (3) is that the manufacturer pays through products liability settlements perhaps 5% of the injury costs of consumer products, i.e., that only 5% of the injury costs show up directly in product prices. Governments, through support of the medical establishment, pay some 30% of product injury costs, I estimate - which show up later in taxes. And uninjured consumers, through insurance distribution, pay perhaps 15% of product injury costs.)

The importance of the testing laboratories and standards bodies in consumer product safety is now growing.

SLOW ACCIDENTS

In addition to our dollar losses for unwise choices in the marketplace, we have our human losses of deaths and injuries while using products. The National Safety Council Accident Facts reports some 115,000 accident deaths and 50 million injuries per year, of the 2 million who die each year in the United States. I call these the "fast accidents," and am looking particularly at the deaths and injuries involving delayed stress effects of our life styles, the "slow accidents" (3) of carcinogens in our products and environments, heavy metals in our streams, deaths and hospitalization (injury) for some people with "diseases" including malnutrition whose cures or prevention are known but not applied, and all other effects of stress that lead to "premature death" and hospitalization. Ralph Nader speaks of the "silent violence" of our society. By a

curve fitting procedure, Figure 2, of the cumulative percent of those who died in 1967 (4) versus the age at which they died, the preliminary suggestion is made that the observed curve could be accounted for by a "biological death" probability distribution with mean age of death of 75 and standard deviation of 12 years, with a 2 percent "tail" of additional deaths prior to the age of 1 year representing the early-lethal effects, together making up 70 percent of the deaths, and a difference curve "stress death," which is within 4.5 percent of being a straight line -- with less deaths before age 50 and more after age 50, curve fitting at 30 percent of the deaths--or 600,000 people per year in the United States.

On the basis of this very preliminary hypothesis, I suggest that in addition to some 100,000 fast accident deaths there are some 500,000 slow accident deaths, and with an estimated ratio of perhaps 500 injuries to 1 death, there are 250 million slow accident injuries per year -- to the extent of getting professional medical treatment or being disrupted from normal activities for at least a full day. Most of us are feeling some discomfort with our technological life style -- although I hasten to emphasize that it is this same technology that lets many more of us live out a biological life span than in years past. The median age of death in Massachusetts in 1850 was 40, and even in 1900 for non-whites it was 33. (4)

The challenge in consumer product safety, then, is not only to reduce at least the involuntary imminent hazard aspects of product use, but also to reduce these continuing hazards of pollution, mutation, exhaustion of raw materials, and other stresses of modern life. By increasing production of food, products, and services over the millennia man has indeed extended the median life span. Now, in this generation, it becomes apparent that much further increased production and populations will decrease the median life span unless we reduce the stress hazards. Living with man rather than living with nature has become the challenge of survival.

INFORMATION VERSUS REGULATION

As Figure 1 indicates, there are several ways in which product injury information could

be more effectively utilized in the marketplace. The government staff could decide what is needed to increase safety and by legislation and regulation require that these changes be made. Many of us are aware of the inadequacies (6) of bureaucratic omniscience, and feel that regulation should deal with only the unreasonably hazardous products.

A major alternative to encourage the use of safe and well-performing products, i.e., products with reduced imminent or delayed hazards, is for the government and the manufacturer to increase the flow of product information to the consumer, to increase his ability to choose safety. We often get the wrong product or the wrong service -- not the one we would have chosen even with our present education if we had been given adequate information about products and services in the marketplace. President Nixon, in his Consumer Message to Congress (7) of February 24, 1971, after noting the major success of our economy, said,

"In today's marketplace, however, the consumer often finds himself confronted with what seems an impenetrable complexity in many of our consumer goods, in the advertising claims that surround them, the merchandising methods that purvey them and the means available to conceal their quality. The result is a degree of confusion that often confounds the unwary, and too easily can be made to favor the unscrupulous. I believe new safeguards are needed, both to protect the consumer and to reward the responsible businessman."

The President then presented legislation to implement the "buyer's bill of rights," including the right to information to make intelligent choices among products and services in the marketplace, and concluded;

"In submitting the foregoing proposals, I want to emphasize that the purpose of this program is not to provide the consumer with something to which he is not presently entitled; it is rather to assure that he receives what he is, in every way, fully entitled to. The continuing success of our free enterprise system depends in large measure upon the mutual trust and goodwill of those who consume and those who produce or provide.

"Today in America, there is a general sense of trust and goodwill toward the world of business. Those who violate that trust and abuse that goodwill do damage to the free enterprise system. Thus, it is not only to protect consumers, but also to protect that system and the honest men who have created and who maintain it that I urge the prompt passage of this legislation program."

What then is the buyer's right to information about products to allow intelligent choices in the marketplace? I shall present a preliminary and personal view here, with the emphasis that it would be a great service of the engineering community and of this conference to refine this list and begin to implement its use.

My view is that, just as one manufacturer would require the following from another manufacturer supplying a product, so the consumer has a right to know

- the name and address of the manufacturer.
If the manufacturer is outside of the United States, the name and address of the importer should also be given
- the model number, and perhaps for products costing over \$100 a serial number of the product
- the date of manufacture
- the design performance under design use conditions
- the design maintenance under design use conditions, and costs
- the design repairs; characteristics, costs, and frequencies under design use conditions
- the design use life under design use conditions
- the standards and test methods followed in design and manufacture
- the quality control utilized. Test methods, frequency of use, results for the design product, and accepted variations for all tested products sold.
- the kinds of accidents and their frequencies and severities for products of this category, and what has been done in this particular product to reduce these accidents
- the residual risks of accident types -- with predicted frequencies, severities, and costs -- for accidents which have

not been avoided by the product design.

These residual risks must remain of user concern.

- warning and hazard instructions--how to recognize and avoid hazards, and what to do if hazards develop
- warranty, if offered, including time and procedures, and the percent of design product use life under design use conditions which is covered by the warranty
- how to get in touch with the manufacturer for complaints, repair advice, etc. Ideally a reverse-charges telephone number such as is being used by one large manufacturer
- user experience concerning performance, repair, problems, etc. as reported to the manufacturer or to the government, or as solicited by the manufacturer from a statistically balanced sample of users. Because of possible conflict of interest problems, this might better be presented as a summary of government complaint and use data rather than as manufacturer data.

The responsible manufacturer, in his design of a consumer product, already has most of this information, and could now put it in a Buyer's Handbook, available on request if not supplied with each product sold. But there is a lot of work to do by industry, by government, by standards bodies, and by all engineers to indeed make this information meaningful to the consumer, and used to reduce waste and hazard in the marketplace.

Dr. Lewis Branscomb, Director of the National Bureau of Standards, presented the buyer's right to information in the following form: (8)

"Information

The buyer needs the answer to three questions about a product:

1. How well will it do the job I want it to do, and for how long?
2. How much does it cost me, now and later?
3. Is it safe? Will it annoy my neighbors?"

The extent to which industry and government supply such information to consumers, so that short-term and long-term safety be-

come factors in the marketplace, will in my view determine the extent that mandatory regulation of safety is considered unnecessary. I suggest the phrase "Cave Consumptorem Prudentem - beware the wise consumer". Either the consumer will be given the information that will let his wise choice in the market correct the unreasonable dangers and waste of incorrect choice, or in his growing political wisdom he will vote to remove these dangers and wastes by regulation. The responsible manufacturer has nothing to fear, and indeed in my view should speed the day of wise choice in the marketplace by preparing a Buyer's Handbook on each model of product sold, with all of the information listed above.

THE MANUFACTURER

In an altruistic world, the manufacturer would practice every known procedure to insure the short term and long term safety of the users of his product. But without altruistic stockholders, his need is to show a profit from his management. He may conclude that since he is only directly paying a small part of the cost of injuries and other failures involving his products, he may do less for safety, in keeping with his own financial realities (9). This condition may prevail until the costs of product failures are at least identified for the information of future buyers if not indeed charged back to the manufacturers.

The National Commission on Product Safety examined the safety practices of a small number of manufacturers of consumer products by means of a Manufacturers Questionnaire. Responses were voluntary, so perhaps better than average performance is practiced by those agreeing to respond. An index representing the percentage of yes responses concerning the performance of recognized systems safety practices was utilized to examine a number of industries (2). Figure 3 illustrates the spread of total responses, from the 20% for the footwear industry - whose questionnaires showed almost no sense of involvement with the problem that the major source of injury in the home is from falling - to the 88% for the power tool industry, who are well aware of tool hazards and attempting to reduce them. Reference 2 should be examined for the kinds of safety practices of certain consumer product industries.

Looking again at Figure 1, the manufacturer could investigate product injury problems directly, and use this information to improve his product. The National Commission on Product Safety found very few manufacturers who had physicians or related personnel visiting hospitals, medical researchers, and injured individuals to learn details of product injury events. Although manufacturer injury investigation personnel, with medical as well as engineering experience, would have difficulty finding appropriate cases to investigate working alone, the time is at hand for at least all large manufacturers to designate staff injury investigators or coordinators to cooperate with the Government in these studies. The patient privacy and investigator conflict of interest issues are important, so that the Government may do much of the initial investigation alone. But the manufacturer in my view should seek his own professional understanding of the public health product injury problem, and not wait for the Government to spell out for him the mandated engineering changes.

THE TESTER

To help assure the safety of a manufactured product one can test the product. "Hazardous or unsafe conditions for individuals using, maintaining, or depending upon the product" are considered "Critical defects" for products supplied to the Government, and "the supplier may be required to inspect every unit of the lot or batch for critical defects." (10)

The individual consumer can make no such 100% inspection requirement, but none the less the trend in consumer product testing is toward 100% production line testing. The cost of machine testing is going down in comparison to the cost of off-line "handcraft era" testing of the older quality control methods, and the savings are going up in detecting a production failure right after it occurs, to minimize rework to correct the failure, rather than detecting the failure after the product is completed.

Further assurance of product design quality can be provided by an independent testing laboratory. It is emphasized that the independent laboratory should oversee the production testing of the manufacturer, and vouch for these test methods as well as for the

quality of the product design. Production failures (i.e., products made not according to design) as well as design inadequacies can lead to hazardous products. A National Conference on Laboratory Evaluation and Accreditation is being developed under the coordination of the National Bureau of Standards to establish procedures to assure, possibly both nationally and internationally, the capabilities of independent testing laboratories in performing defined tests.

But there are many aspects of consumer product use for which there are no defined tests. The National Commission on Product Safety found that for many consumer products there are no published standards (which typically include test methods). The Administration has proposed, with bipartisan support, a Consumer Product Test Methods Act, H.R. 6891," a bill to provide incentives for increasing the amount of information available to consumers respecting consumer products." The Secretary of Commerce, in consultation with the Office of Consumer Affairs, would promote the development, approval, and use of methods for testing for consumer product characteristics whose measurement would be in the interest of consumers. Suppliers could then elect to advertise the results of these authorized tests, and their use of accredited testers. Consumers would receive more useful quantitative information to aid their choices in the marketplace. The supplier reporting on a test in advertising or elsewhere would be required to fairly disclose the complete results of such testing. This legislation could provide a measurement language for the consumer interest, and be an important element in providing the buyer's right to the information that would allow intelligent choice in the marketplace.

THE RETAILER

The retailer today takes a limited responsibility for the safety of the products he sells. Only a few of the large retail chains (for example, Sears Roebuck, J. C. Penney's, and Macy's) have their own testing laboratories, and these are used more for buying decisions than for continuous quality control checks. One may note that the second largest United States retailer, the Armed Forces Post Exchange systems, are not prominent for the testing of the products they sell.

At best, the retailer passes on the manufacturer's information to the consumer, perhaps confirming some of it. More typically, the retailer is lost in the information retrieval problem, and gives the consumer only partial answers if not wrong ones.

Some retailers, particularly in their repair operations, are utilizing microfilm or microfiche data systems to rapidly select from large amounts of information the particular model and part of interest. I foresee a further growth of manufacturer information retrieval with the development of computer information and data systems, already beginning to be used for inventory and customer charging purposes. It is a small step for the salesman who can use a computer to see if he has a given model and color in stock for him also to search data supplied by the manufacturer to see the characteristics of that model. At that point, the salesman becomes the tutor of the consumer in the searching for data to allow intelligent choice. Advertising would emphasize information transfer.

THE CONSUMER

Many consumers, of course, will still elect an uninvolved contact with the marketplace, buying on whim, buying on short-term emotional interests which have no place for risk calculations. We cannot make the world "safe", but we can try to make it safer, and education can show the benefits of this effort. With half of today's highschool graduates taking some college work, and with the efforts of Mrs. Virginia Knauer and the Office of Consumer Affairs to increase consumer education, the day of the wise consumer, *consumptorem prudentem*, may be at hand. We speed the day by asking for information to allow intelligent choice.

What is the waste today of a marketplace in which the consumer does not have full information to allow intelligent choice? Of the \$700 billion spent by consumers for goods and services, how much is spent unwisely, not satisfying the need that would have been satisfied if we had the information for intelligent choice? How many frauds do we suffer, how many wrong repairs are made, how many wrong services are performed, how often do we buy the wrong product? If we include only the difference in

cost of the satisfaction of what we bought and what we would have bought if we had had information for intelligent choice, are we 85 percent right in our purchases? Perhaps indeed we are not that successful. Each of us should reexamine his goals and see what information he lacks in making choices in the marketplace to attain them. That 15% that we may be wrong (unnecessarily unsatisfied) is \$100 billion, so the buyer's right to information has a golden benefit indeed, and significant costs to insure this right are justified.

THE REPAIRER

Complex products may become unsafe in unsuspected ways with attempts at repair. The necessary trend is that the repairer become increasingly professional, following standards and certifying successful testing of his work. The manufacturer, concerned about his liability, will want to know the repairer's effect on the product and may best protect his name by providing repair services.

THE DISPOSER

Products must increasingly be made with disposal and recycling in mind. This must be planned into the design; the manufacturer may well be the one who should have the responsibility for efficient disposal and reuse. The practice should be encouraged that when a new product is received, the old one is taken away.

TRADE AND PROFESSIONAL ORGANIZATIONS

These bodies have represented the narrowly defined interests of their constituents, but are increasingly recognizing broader social responsibilities as well. Let them speak out on product safety, organizing the special experiences of their members.

NATIONAL AND INTERNATIONAL STANDARDS BODIES

Standards and test methods are the necessary language of informed choice. Even with some 19,000 U.S. voluntary engineering standards, (12) published by some 360 U.S. technical societies, professional organizations, and

trade associations, the consumer standards needs have just begun to be emphasized. Growing world trade is aided by international standards (13) and the "multi-partite" agreements to accept test results across national borders.

GOVERNMENTS

State and local governments, with their building codes, electrical codes, and other regulations have an increasing influence on local commerce. The issue of preemption of local mandatory standards by Federal mandatory standards, even when the Federal standard is weaker, is not finally settled by legislatures or courts. Communication is important to minimize differences; the National Bureau of Standards secretariats of the National Conference of Weights and Measures and the National Conference of States on Building Codes and Standards have been quite successful in helping to draft the Model State Packaging and Labeling Regulation, The Model State Lumber Regulation, and in preliminary efforts to consolidate building codes and redirect them toward performance criteria to allow use of new methods for Project Breakthrough. (14)

Communication cannot erase regional needs for differences of regulation to deal with regional problems of very low temperature, earthquake, hurricanes, etc. The courts, considering preemption, may be expected to respect these needs. The challenge is to write the Federal regulation to include these special circumstances.

But how far a state can get ahead of the nation in general safety requirements remains an issue of our time. Minnesota's efforts to place the emission standards below the Federal standards for nuclear power plants have thus far been denied in the courts.* Consumers may indeed develop local values and wish to defend them by local standards, if these are not recognized by the Federal Regulation.

The Federal Trade Commission is increasing its communication with local consumer protection groups, establishing in many areas Consumer Protection Coordinating Commit-

*Northern States Power Co. v. Minnesota, U.S. District Court, Minnesota, December 22, 1970. See 39 Law Week 2367, 2368, January 12, 1971.

tees (7) of local district attorneys, attorneys general, consumer protection offices, Federal inspectors, weights and measures people, law enforcement people, etc., to insure that local needs are recognized in Washington, and successful methods are shared.

COMMUNICATION

The complexity of the "safety system" that affects the safety of consumer products is such that an interactive computer Product Information Service is essential to let the many participants in the safety system keep up with the many changes and have access to the inclusive representations of problems and data. An interactive computer system lets the user receive an answer to his question, and not have to sort this answer from page after page of printed text selected to answer many questions. A prototype system was the Consumer Product Safety Index (15), although this never reached the interactive stage.

The service should receive from participants (each of whom would sign his name, organization, and date of input) information on

- injury statistics
- case histories (without privacy aspects)
- economic data (products in use)
- demographic data (user characteristics)
- complaints and analyses
- products
- technical information (publications)
- possibilities for product improvements (patents, etc.)
- standards
- benefit-cost analyses of mandatory standards
- legislation
- court actions
- professional people involved (addresses and phone numbers)
- manufacturers
- testing laboratories

and other information needed to make and choose the safer and more useful products that the informed consumer will wish to buy. The system would be intimately cross indexed and subject indexed, so that ideas would lead to related ideas, and each of us would not have to rediscover elsewhere what others of us have found and entered into the system.

Now we have, as Thoreau said, the matter of "putting foundations" under our "castles in the air." What does it cost you not to know these things?

CONCLUSION

The world is significantly less safe because most of us are not aware of our hazards. With computer information techniques, the convenience of identifying these hazards will allow us to use this knowledge to reduce our hazards. How thoroughly we act with knowledge may yet determine the survival of mankind. As H. G. Wells put it (Outline of History, 1920), "Human history becomes more and more a race between education and catastrophe."

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Safety Interfaces

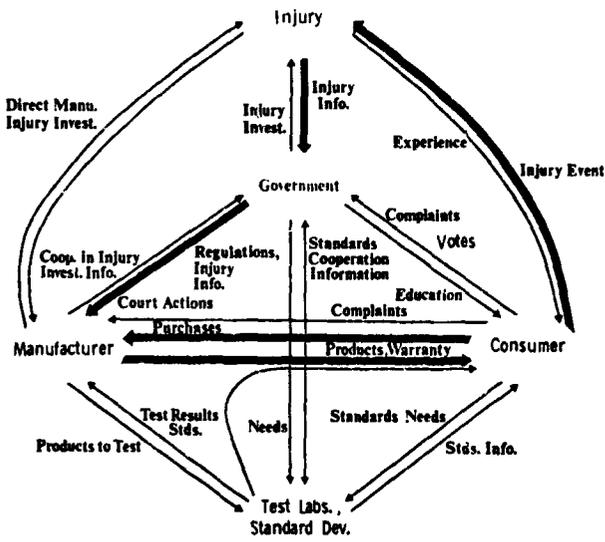


FIGURE 1

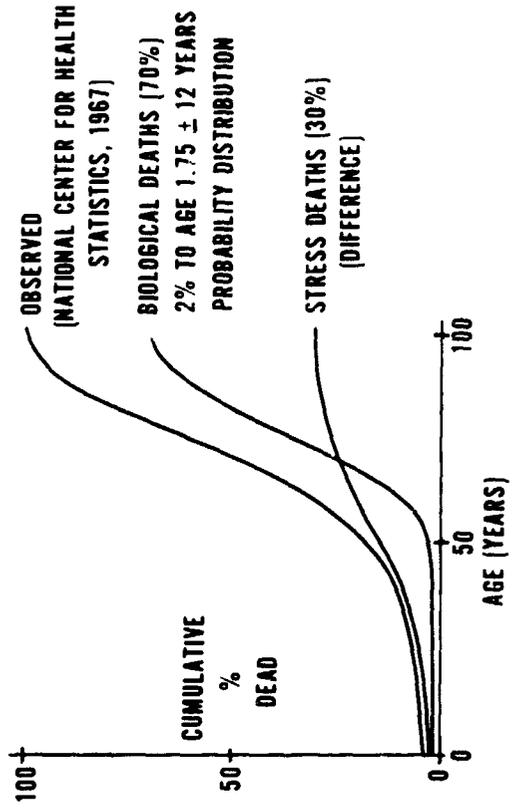


Figure 2 A curve fitting hypothesis concerning biological and stress deaths

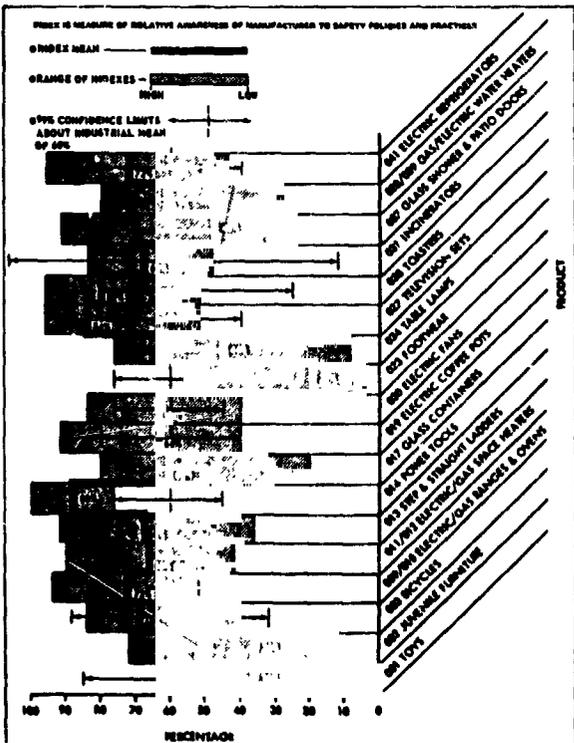


Figure 3 Average Index Per Manufacturers Product Code