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MALADJUSTED CONTRIVANCES AND CLUMSY AUTOMATION: A JURISPRUDENTIAL INVESTIGATION

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TABLE OF CONTENTS

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I. INTRODUCTION

Concerns about machinery have bedeviled the popular imagination since the time of the Industrial Revolution. Contemporary society is becoming increasingly apprehensive that it has lost mastery over its technological creations and is coming to serve them instead. We are growing to fear our own contrivances.[1]

The prevalence of this fear is scarcely puzzling when we note that human-machine interaction in our modern society can be most charitably characterized as an uneasy truce. Our technological devices are too seldom designed with a view to the capabilities and shortcomings of their human users. Examples of this problem abound, from the familiar, such as VCRs that no one can program and vending machines whose interfaces frustrate and confuse, to the more exotic, such as the devices used to operate airplanes and nuclear reactors, the poor design of which contributes regularly to catastrophes of "human error." Clearly, then, a greater emphasis on human-centered design of technological devices is warranted. But this statement, uncontroversial as it is, raises a host of questions: Can the goal of human-centered engineering be realized? If so, how? Will the market pay for it, or must the government oversee its implementation, either through legislation or through the rules of common law liability?

This Article seeks to demonstrate that understanding the way judges have approached the problem in applying and crafting the common law can advance the goal of human-centered design. In particular, it

1. Note, however, that this fear coexists with antithetical sentiments. To popular culture, television's fantastic bionic heroes make the classical Byronic hero seem timeworn. Schools are eliminating instruction in venerable human dialects such as Greek and Latin and teaching machine vernacular such as BASIC or PASCAL instead. This bipolar attitude is also manifested in architecture. Since the early twentieth century, modern architects such as Le Corbusier and Van der Rohe designed machines in which humans could live and work. The values of humanistic architects whose buildings recapitulated the proportions of the human body and echoed humane urbanity were discarded by modernism. Since humanistic structures seemed ill-suited to mechanized living, housing was built for machinery, and people, who are more adaptable than machinery, are now expected to live in a machine's house. *See generally* PETER BLAKE, FORM FOLLOWS FIASCO: WHY MODERN ARCHITECTURE HASN'T WORKED (1977).

examines two legally significant consequences of faulty interface design: human error and the inadequacy of automated replacements for human actors. Part II provides an overview of the interaction between human-centered design and the law. It introduces the concept of "redundancy," or those aspects of interface design that accommodate human needs. Part III explains how redundancy can reduce the incidence of human error by accounting for human limitations. Part IV explores the types of human attributes automated devices will likely have to emulate if they are to replace humans, as well as the problems that the failure to include such attributes can engender.

The law's potential for contribution in this area is twofold: (1) the opinions of judges can provide useful insight into the nature of the problem and possible design solutions; and (2) the rules of common law liability can and should foster human-centered design where the market fails to do so. In general, the engineering community has paid insufficient attention to the law's role in advancing human-centered design. As this Article illustrates, this lack of attention is unfortunate, and both engineers and lawyers stand to gain much by correcting it.

II. HUMAN-CENTERED DESIGN AND THE LAW

As the century draws to a close, it is apparent that designers have begun to direct their ingenuity to themes of amenity. Architects are once again mindful of humane constraints on the design of buildings.[2] Widespread acceptance of user-friendliness as a cardinal design virtue is transforming ergonomics into an ideology. User-friendliness has so caught the public's imagination that it has become assimilated into popular culture.[3] We continually challenge technology to provide us with better tools, systems, and procedures. "Better" in this context is coming to denote the achievement of such humane objectives as enhancing human performance, improving the way we interact with our environment, and, indeed, enriching our lives. Technologists seem to be seeking absolution for their offenses in a creed of usability, an impetus to anthropocentric design that portends the unfolding of a comprehensive technological ideology.

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2. *See, e.g.*, R. SOMMER, SOCIAL DESIGN: CREATING BUILDINGS WITH PEOPLE IN MIND (1983).

3. Searching NEXIS, News Library, Majpaps File, for stories published since January 1, 1990, about the "Graphical User Interface" yields well over 300 stories.

Nevertheless, Donald Norman,[4] the preeminent theoretician of human-centered design, has expressed disappointment at how little industrial design has been influenced by advances in our understanding of the psychological mechanisms that bear on human error.[5] This Article relies frequently upon Norman's work in explaining the conceptual underpinnings of human-centered design.[6]

A cognitive scientist, Norman left academia to become Apple Computer's "user-experience architect." In that role, he set himself to the task of ensuring that "considerations of the user experience take a major role in defining and supervising the creation" of Apple's products.[7] His analysis of human-machine interaction will be invoked repeatedly to illustrate the conceptual relationships among concerns familiar to both the legal and the human factors communities. As the reader will notice, the cases arising from design foibles have frequently anticipated the conclusions of contemporary human factors scholarship.

A. The Human-Centered Design Perspective

1. Donald Norman's Work

Humankind is drowning in a sea of machinery. The notion that technology has taken over society and humans have become slaves to their own creations is hardly a novel one. Well over a century ago, George Moore wrote: "The world is dying of machinery; that is the

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4. Donald Norman is Professor Emeritus at the University of California at San Diego and the founding chairman of its cognitive science department. He has authored or co-authored eleven books on cognitive psychology and user-centered design as well as numerous related articles. His book THINGS THAT MAKE US SMART: DEFENDING HUMAN ATTRIBUTES IN THE AGE OF THE MACHINE (1993) [hereinafter THINGS THAT MAKE US SMART] directs our attention to artifacts fashioned to assist human understanding ranging in complexity from diagrams, tabulations, maps, and other relatively unsophisticated representations of reality, to complex computer-based systems. He asserts that cognitive artifacts intended to augment the proficiency of our minds are often designed to suit the artifact's designers and producers instead of its users.

5. *See, e.g.*, Donald A. Norman, *Human Error and the Design of Computer Systems*, 33 COMM. ACM 4 (1990); *see also* Howard Schlossberg, *Reaction Mixed to Psychologist's Crusade for Better Product Design*, MARKETING NEWS, April 13, 1992, at 1; Roxanna Li Nakamura, *A Surge in Human Factors Engineering Is Helping Software Companies Build Friendlier Programs*, INFOWORLD, November 19, 1990, at 51.

6. DONALD A. NORMAN, THE DESIGN OF EVERYDAY THINGS (1990); DONALD A. NORMAN, TURN SIGNALS ARE THE FACIAL EXPRESSIONS OF AUTOMOBILES (1992) [hereinafter TURN SIGNALS]; NORMAN, THINGS THAT MAKE US SMART, *supra* note 4.

7. Letter from Donald Norman to the author (Dec. 6, 1993).

great disease, that is the plague that will sweep away and destroy civilization; man will have to rise up against it sooner or later . . . ."[8]

Donald Norman has expressed comparable sentiments:

> I fear that the rush to autonomous machines is proceeding too rapidly. Our machines are barely social now. They are still at an early stage of development, still primarily self centered, still focused on their own needs and not those of their operators. What will happen when they are given more power, more authority? How can we shape the evolution of machines so that they become more humane, more in line with human needs and values?[9]

Norman's sentiments, however, stand in opposition to the intellectual tradition represented by George Moore, because he posits a technological crusade to improve the human condition by making machinery more beneficent: "The goal is not to eliminate technology, it is to modify it, the better to serve human needs."[10]

In *The Design of Everyday Things*,[11] Norman articulates the annoyance and irritation people experience when unable to assemble a child's toy, program a VCR, or even set a digital watch. Who hasn't experienced the frustration and helplessness accompanying a stay in a hotel where bureaus and cabinets have hidden handles able to be opened by only those privy to the secrets of their design? How many callers have been stymied by voice-mail systems designed for the convenience of the person being called rather than the caller? Norman assures countless consumers that they are not alone. Transactions with modern technological artifacts frustrate those who believe misadventure results from ineptitude and encourage the more paranoid to imagine themselves as the targets of a colossal machine conspiracy. Norman attributes this grievous mischief to the failure of engineering professionals to adequately account for "human interface" factors in product design.[12]

In *Things That Make Us Smart: Defending Human Attributes in the Age of the Machine*, Norman focuses on computational artifacts and

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8. GEORGE MOORE, CONFESSIONS OF A YOUNG MAN 124 (1916).

9. Norman, TURN SIGNALS, *supra* note 6, at 134.

10. Donald Norman, *quoted in* Nora Zamichow, *Gadget Guru; Professor Wants Machines to Serve, Not Control*, L.A. TIMES, Aug. 5, 1991, at A3.

11. NORMAN, THE DESIGN OF EVERYDAY THINGS, *supra* note 6.

12. Norman defines "human interface" as "the part of the technological system that interacts with the person — the knobs, lights, meters, gears, computer displays, buttons, and pointing devices that form the 'interface' between machine and human." NORMAN, TURN SIGNALS, *supra* note 6, at 109-10.

computers. He argues that these should be fitted to human capabilities by enhancing mental aptitudes, such as "reflection," and displacing the performance of cognitive tasks for which machine intelligence is superior, such as "computation" or "memory." Exploring the way we interact with machines in order to improve product design, the book delves into the enigma of how people learn to use technological artifacts. According to Norman, the predominant design characteristic of the products to which people fall victim is the inclusion of features that accentuate mechanical proficiency at the expense of capacities directed toward humane functions such as ease of use or, more critically, "idiot-proofing."[13] The "suitability" of computer-based systems must be assessed on the basis of how well they are fitted to the way humans think and act. He sermonizes: "Right now, technology lacks social graces. The machine sits there, placid, demanding. It tends to interact only in order to demand attention, not to communicate, not to interact gracefully."[14] To achieve civility in a machine, faculties of the mechanism devoted to humane functions must be emphasized at the expense of the general efficiency of the system.

The degree of computer literacy required to interact with today's computers underscores the deference designers have given to the computational procedures of the machine. The vitality of human thought suffers when interaction with a computer requires fluency in an arcane computer language. Forcing humans to adopt the logical constructs of

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13. Norman explains idiot-proofing as a design standard:

> If an error is possible, someone will make it. The designer must assume that all possible errors will occur and design so as to minimize the chance of error in the first place, or its effects once it is made. Errors should be easy to detect, they should have minimal consequences, and if possible, their effects should be reversible.

NORMAN, THE DESIGN OF EVERYDAY THINGS, *supra* note 6, at 36.

From the standpoint of product liability predicated on design defects courts adopt idiot-proofing as the applicable legal standard. For example, in Cepeda v. Cumberland Eng'g Co., 386 A.2d 816 (N.J. 1978), the court pointed out: "It is, however, clear that many, if not most jurisdictions now acknowledge that in applying strict liability in tort for design defects manufacturers cannot escape liability on grounds of misuse or abnormal use if the actual use proximate to the injury was objectively foreseeable." *Id.* at 828. *See also* Robinson v. GGC., Inc., 808 P.2d 522 (Nev. 1991) (holding that adequate warnings will not shield a manufacturer from liability if hazards could have been avoided by a design modification or safety device that was commercially feasible at the time the product was placed in the stream of commerce).

14. NORMAN, THE DESIGN OF EVERYDAY THINGS, *supra* note 6, at 117.

machine intelligence imposes a stultifying and artificial constraint on a spontaneous and instinctive intelligence.[15]

Things That Make Us Smart calls for the reconstruction of human interface components in everything from household items to computers, to make them more effectively serve human needs. If machinery is to serve humanity, technologies must not overemphasize mechanical efficiency and fail to account for human weaknesses. The slogan of the 1933 Chicago World's Fair — "Science Finds, Industry Applies, Man Conforms" — sums up all that Norman finds disquieting. Certainly, he observes, it is science and industry that should be made to conform: "Now, as we enter the twenty-first century it is time for a person-centered motto, one that puts the emphasis right: People Propose, Science Studies, Technology Conforms."[16]

2. Ergonomics

The parallel, albeit heterogeneous, disciplines denominated "human factors engineering," "engineering psychology," the "study of human factors," "human factor analysis," and "ergonomics" investigate the manner in which congenital physical capacities and deep-seated human behaviors dovetail with the tools and expedients we utilize to perform various tasks. Knowledge acquired from human factors research is applied to the task of harmonizing the design of tools and artifacts with innate human aptitudes and limitations.[17]

Both philosophically and methodologically, user-centered design objectives have invariably been approached from an interdisciplinary perspective. Seemingly isolated advances in such disparate disciplines as industrial design, cognitive psychology, and software programming

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15. The above sentiments mirror the admonition of Judge Bruce Jenkins in another context: "[O]ne should be unconcerned when computers begin to think like men, but [] one should be greatly concerned when men begin to think like computers. Calculation is a function far different than judgment — a distinction which has great consequences for the whole social structure." United States v. Swapp, 719 F. Supp. 1015, 1026 (D. Utah 1989).

The Apple Macintosh and Microsoft Windows interfaces demonstrate that communication with computers need not be burdensome or unnatural. The practical objective is to create programming that will allow people to use computers without becoming "computer literate" to the same extent they are now able to enjoy television programming without being "television literate." As people experience this ease of use, the inclination to use computers will increase, as will the tasks assigned them. Nevertheless, much greater headway must be achieved in computer integration before we can expect computer technology to empower ordinary people.

16. NORMAN, THINGS THAT MAKE US SMART, *supra* note 6, at 253.

17. *See generally* Donald A. Norman, *Design Rules Based on Analyses of Human Error*, 26 COMM. ACM 254 (1983).

have yielded insights of reciprocal significance, generated design concepts of generic adaptability, and fostered important advances in computer-human integration.[18] Architects, industrial designers, and engineers collaborate with psychologists and social science specialists to identify those aptitudes and inadequacies of potential users likely to bear upon the serviceability of a contemplated contrivance. Whether engineer or psychologist, human factors specialists reach beyond the spheres of activity in which they are trained to assimilate insights and experimental techniques of other disciplines.

Yet among many working scientists and engineers, intercommunication for the purpose of enhancing anthropocentric design is often impaired by a predisposition to ignore scientific and engineering methodologies in studying humans, and psychological techniques in designing machines. Even the computer industry, which has become the strongest proponent of user-centered design, has not been immune from the parochial attitudes endemic to interdisciplinary enterprises.[19] Approaching interface design from their own narrow viewpoint, applications programmers have tended to produce overly demanding and unnecessarily confounding software, a phenomenon that led hypertext's inventor to assert: "Historical accident has kept programmers in control of a field in which they have no aptitude . . . . Learning to program has no more to do with designing interactive software than learning how to touch type has to do with writing poetry."[20] The notion that apprehending human-machine interaction from a legal point of view may have consequential design implications has also been overlooked. The programmer's indifference to producing the "friendlier" interfaces consumers have come to demand parallels the industrial designer's

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18. *See generally* BEN SHNEIDERMAN, DESIGNING THE USER INTERFACE: STRATEGIES FOR EFFECTIVE COMPUTER INTERACTION (1987).

19. For a discussion of earlier computer designs which emphasized usability as the predominant factor in human-computer interaction, see David C. Smith et al., *Designing the Star User Interface*, BYTE, Apr. 1982, at 242. Apple Computer's user-friendly Macintosh software evolved from Xerox's Star interface. Apple utilized a "Human Interface Group" comprising psychologists, technical writers, and graphic designers as well as computer scientists to develop its system. Macintosh computers popularized "graphical user interfaces," an underlying set of instructions that administer basic computer routines in a manner permitting users to control computers with a pointing device that manipulates an arrow on the monitor. This method of interaction disentangles users from the inconvenience and frustration of having to type from memory miscellaneous strings of cryptic characters in order to communicate with their computers. Users of a graphical user interface communicate, instead, by pointing to pictures associated with their objective. Microsoft Windows is currently the world's best selling computer program.

20. Jordan Powell, *Designing For Users*, DATA BASED ADVISOR, Nov. 1991, at 54.

disinclination to apprehend man-machine interaction from a legal point of view.

B. What the Law Can Contribute

Legal scholarship and jurisprudence can further the cause of human-centered design in at least two ways. First, the scholarship of cognitive science and its application to product design is of fairly recent vintage. Only over the past decade has it evolved to encompass studies of human interaction with technological artifacts; yet judges have ruled on cases involving automation technologies for almost a century. Thus, at least where a failure of interface design has given rise to legal liability, written opinions of courts represent judicial attempts to grapple with the problems of human-machine interaction. Dealing with misbegotten human-machine interactions *ex post*, judicial opinions can provide helpful insights into the problem. Although judges have had a good deal to say on the subject, the law's role in interface design remains largely unrecognized.

Legal scholarship is particularly well-suited to provide guidance to the human factors specialist because of the crucial role failure plays in any evolutionary process. It is by examining and correcting the deficiencies that have contributed to a failure that headway is achieved in the design professions. Case law provides a readily accessible accumulation of accounts and assessments of design failures that transpire in the laboratory of everyday use. Appreciation of lessons learned in the trial and error of everyday use is the mechanism of progress.[21] Viewing case law as a design laboratory brings to mind the oft-quoted teaching of Oliver Wendell Holmes that: "[T]he life of the law has not been logic: it has been experience."[22] Design professionals must not become so infatuated with the aesthetics of their pursuits that they overlook this cornucopia of experience. It is unfortunate that designers and engineers are more likely to interact with lawyers as defendants or expert witnesses than as collaborators in advancing human-centered design.

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21. *See generally* HENRY PETROSKI, TO ENGINEER IS HUMAN: THE ROLE OF FAILURE IN SUCCESSFUL DESIGN (1985).

22. OLIVER WENDELL HOLMES, THE COMMON LAW 1 (1881). Many years later Justice Holmes enshrined this admonition in the jurisprudence of the Supreme Court with the formulation "a page of history is worth a volume of logic." New York Trust Co. v. Eisner, 256 U.S. 345, 349 (1921).

Furthermore, anthropocentric amenities are often in tension with economic and technical considerations.[23] A slight enhancement of humane features may overbalance the requisite expense or inefficiency in some instances and not in others. Design decisions invariably involve a cost-benefit or risk-utility analysis[24] in which marginal improvements in the sociability of a technology are weighed against the burden of providing them. Risk-utility analysis is a uniquely legal expertise.

Second, though poorly designed interfaces can cause inconvenience, hardship, and even serious injury and cost, manufacturers operating in the free market may not always cleave to human-centered principles. To be sure, competition among creative entrepreneurs seeking consumers has long been the engine of innovation. If consumers want ease of use, market mechanisms will spur its design and availability for sale, and human-centered technologies will be assimilated through an inevitable, albeit gradual, process. However, this assertion presumes a process of continual modification that provides consumers with desirable products

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23. The computer industry is an apparent exception, for it has been relatively immune from the economic constraints on user-friendly design. One reason human factors engineering has had such an extraordinary impact on the design of present-day software is that the computer industry has consistently outstripped the predictions of its technological prophets. In defiance of economic constraints which circumscribe most other businesses, it has consistently provided an ever-increasing quantity of computing power at a constantly decreasing cost. For this reason, the performance of user-friendly application software has been dependent upon the ingenuity of programmers to a greater extent than on economic considerations or technical limitations. A software engineer at NeXT Computer Company noted: "On the desktop today 80% of computing power is going toward ease of use, such as menus, windows, and pop-ups. Only 20% is actually going toward doing the job, such as calculating your spreadsheet." Bruce Nussbaum & Robert Neff, *I Can't Work This Thing*, BUS. WK., Apr. 29, 1991, at 84.

24. This is a form of cost-benefit analysis whose first articulation was Judge Learned Hand's famous restatement of the legal standard for negligence in terms of a formula with three variables: "[I]f the probability be called P; the injury [or loss], L; and the burden [of whatever precaution is required to avoid the loss] B; liability depends upon whether B is less than L multiplied by P: i.e., whether B<PL." United States v. Carroll Towing Co., 159 F.2d 169, 173 (2d Cir. 1947).

Judge Hand himself recognized that his risk-utility formula did little more than add a veneer of precision to the commonplace assumption that reasonable people evaluate whether the advantages of a proposed course of action outweigh its risks:

> [O]f these factors care is the only one ever susceptible of quantitative estimate, and often that is not. The injuries are always a variable within limits, which do not admit of even approximate ascertainment; and, although probability might theoretically be estimated, if any statistics were available, they never are; and, besides, probability varies with the severity of the injuries. It follows that all such attempts are illusory, and, if serviceable at all, are only so to center attention upon which one of the factors may be determinative in any given situation.

Moisan v. Loftus, 178 F. 2d 148, 149 (2d Cir. 1949).

of ever-greater value and ease of use. In any market, gaps necessarily exist between the demand for humane design, the availability of user-centered technology, and the willingness of entrepreneurs to invest in designs to suit people as well as to perform functions. When the market mechanism is inadequate to the task, the law's role in stimulating anthropocentric design may well be pivotal.[25]

Of course, many commonplace designs lie beyond the ambit of legal control. How often do we encounter doors with large flat push handles upon which the word "PULL" has been inscribed? Although people see the "PULL" sign, most continue to "push" rather than "pull," feeling frustrated when the foolish door does not open the way it "should."[26] Quite simply, human mentality associates large flat handles with pushing, not pulling. Many of the design debacles that Donald Norman brings to our attention are caused by the absence of such amenities as civility[27] — failures that are merely exasperating and do not engender catastrophic outcomes.[28]

Frequently, however, thoughtless design results in injury or damage rather than mere annoyance; in such cases, courts have occasion to adjudicate product liability issues such as inappropriate use, defective

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25. *See* Howard Schlossberg, *On a Crusade for Better Design*, MARKETING NEWS, Mar. 30, 1992, at 44 (noting that "Norman is confused a bit because, 'consumers, on the whole, have not complained very loudly about this.' Until they do, U.S. companies 'are not going to bother [improving designs] unless they see it's to their benefit.' He hopes it won't be long until those days arrive").

This idea is familiar to anyone who has studied tort law. Under the doctrine announced in The T.J. Hooper, 60 F.2d 737 (2d Cir. 1932), if the defendant has not sought out and used the best technology available, it is no defense to a claim of tort liability that industry practice is laggard. The standard of "best available technology" for mechanical devices thus provides an analogue to the "ordinary reasonable man" standard by which tort law judges human conduct.

As technology changes, the legal duties imposed on people change as well. For example, in American Mach. & Motor Co. v. UPS, 383 N.Y.S.2d 1010 (Civ. Ct. 1976), plaintiff sued a carrier for accepting an altered check which was returned unpaid. The computerized account number on the check was cut off and another number typed in its place. A post office box number had been typed on the check although the goods were invoiced and delivered to a street address. The court refused to follow an 1879 precedent holding that unconditional acceptance of a worthless check by the shipper from his carrier ratified the carrier's act of receiving it. Instead, the judge looked to the markedly different circumstances created by the technological development of the intervening century. Advances in communication had made it reasonable and, in the court's view, mandatory for the carrier to contact the shipper before accepting a check that had been tampered with.

26. NORMAN, THE DESIGN OF EVERYDAY THINGS, *supra* note 6, at 87-92.

27. On the definition of civility, see *infra* text accompanying notes 107-17.

28. Note, however, that even when design defects do not engender the sorts of fateful outcomes that tend to occasion legal liability, the expedients developed in response to grievous dangers may, in time, be used to provide amenities as well.

manufacture, or defective design. Commenting on familiar automobile radios that are almost impossible to use, Donald Norman admonishes: "Wait until somebody sues an automobile manufacturer because they tried to change a station on the radio and crashed into the next car."[29] The law of products liability compels manufacturers of industrial machinery to utilize interfaces capable of preventing injuries in circumstances where safety devices have been circumvented.[30] The foreseeability of users' carelessly or intentionally bypassing safety appliances has made it common for industrial machinery to be designed with backup safety mechanisms such as electronic interlocks. In light of the ease with which electronic interlocks may be incorporated into machinery, they have been made obligatory by general standards of product safety. Many automobiles now feature an interlock device that prevents the vehicle from starting unless the operator's foot is on the brake, a scheme that prevents accidents caused by cars that lurch forward uncontrollably upon being started. Widely-used interlock devices automatically turn on the headlights when windshield wipers are in use, turn them off when the ignition key is removed, and prevent drivers from carelessly locking their keys in the car.

Courts have imposed design constraints on the deportment of automated facilities as they have come to be assimilated into the mainstream of commercial activity. These cases demonstrate that human-centered design is as much circumscribed by legal standards as by commercial morality.[31] Thus, the belief that machines must be made to conform to human needs and that humans should not be expected to adapt themselves to mechanical convenience has been enforced in the courts. In *Allen v. Beneficial Finance Company*,[32] for example, the U.S. Court of Appeals for the Seventh Circuit upheld the imposition of statutory penalties and attorney's fees against a lending institution for its failure to comply with the Truth in Lending Act.[33] The Beneficial

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29. *Design Disability: The Simplest Products Are Almost Impossible to Use*, 1 MARKETING MGMT. 6 (1992).

30. *See generally* Cepeda v. Cumberland Eng'g Co., 386 A.2d 816 (N.J. 1978).

31. Commercial morality refers to those mores of the marketplace that implicate marketing and manufacturing issues. From the standpoint of commercial morality, anthropocentric design and engineering is constrained only by the manager's ability to produce user-friendly products within profit-margin objectives, and by marketing considerations such as consumer acceptance.

32. 531 F.2d 797 (7th Cir. 1976). *See also* State v. Hunter, 7 Computer L. Serv. Rep. 980 (Md. Cir. Ct. 1980); State *ex rel.* Gabalac v. Firestone Bank, 346 N.E.2d 326 (Ohio Ct. App. 1975); Burnett v. Westminister Bank, [1965] 1 Q.B. 742.

33. 15 U.S.C. § 1601 *et seq.* (1994). To assure compliance with the broad mandate of the Act, the Federal Reserve Board's Regulation Z requires information relating to the terms of a loan and the cost of credit be presented to borrowers in a logical and

Finance Company contended that providing borrowers with computer-generated statements produced by the national computer system with which it was affiliated fulfilled the requirements of the Act. While the computer-generated statements contained all the data required by the statute, the court found that presentation of the required information in a format adapted to the constraints of a computer system were unnecessarily confusing. Sacrificing the quality of the required disclosure would not be excused on the basis of the lender's convenience or the computer's limitations.[34] By imposing statutory penalties and attorney's fees for failure to comply with the Truth in Lending Act,[35] the court compelled the redesigning of the deficient system. Engineers, product designers, and cognitive psychologists who work to create user-friendly interfaces and reformulate the way people interact with everyday machinery may discover that judges have set the design specifications of their handiwork.[36]

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sequential order such that an ordinary borrower could be expected to understand. 12 C.F.R. § 226.1 *et seq.* (1996).

34. *Allen*, 531 F.2d at 804.

35. *Id.* at 806.

36. Compare State v. Hunter, 7 Computer L. Serv. Rep. 980 (Md. Cir. Ct. 1980), in which a Baltimore circuit judge overturned a driving conviction because the computer printout containing the charge given to the motorist was judged incomprehensible to the average person. Code numbers were substituted for a narrative statement of the infraction to streamline the processing of court papers. Since these printouts are not readily understood by persons charged with violations, Maryland traffic courts now staple a copy of the original traffic ticket to the computer generated form.

See also Burnett v. Westminster Bank, [1965] 3 All E.R. 81 (Q.B.), which involved a bank customer who maintained separate checking accounts at two different branches of a bank that used the familiar magnetic character recognition machinery to identify checks processed for payment. Along the bottom of each of plaintiff's checks was the appropriate "MICR" coding indicating the account and branch on which it was to be drawn. When plaintiff had run out of checks for his account at the first branch, he attempted to substitute a check encoded for the second branch. When plaintiff subsequently attempted to stop payment on the check through the first branch, the bank failed to honor the stop payment because its computerized equipment had in the meantime cleared the check through the second branch in accordance with the MICR coding printed on the check. Westminister Bank argued that its MICR system was explained on the front of its checkbooks and that the customer was restricted to a use of checks that was compatible with the limitations of its computerized system. The court, however, held that plaintiff was not bound to a such a restricted use of checks absent an express agreement to that effect.

What if Burnett had signed an agreement restricting checking account services to a use of checks that was compatible with the bank's MICR technology? Given the technological expertise needed to understand how a computer would read and process MICR information, it is unlikely the customer would have any idea what he was agreeing to. It is also unlikely that he would be able to obtain a checking account without agreeing to be bound. The extent to which contracts in which a layman agrees to be bound by characteristics indigenous to complex automated machinery that he would not

As may be seen in the cases examined below, courts have come to appreciate that the growing sophistication of technology and increasing complexity of society require that policy decisions relating to technological innovation be treated as legal issues. Innovators are constrained to conform their inspiration to evolving principles of law that will establish the minimum criteria for the implementation of automation technology. It will not be claimed that the judicial response has been adequate to this epochal task, only that forces of technological innovation have not worked their will altogether unrestrained by legal control. As automation technology increasingly comes to play a significant role in our lives, it is pertinent for lawyers to assess the extent to which automation technology is being kept within the bounds of human governance and control.

The Article now explores the way in which legal analysis can shed light on two particular manifestations of the problem of human-machine interaction: (1) human error caused by poorly designed interfaces and (2) automated devices that occupy roles historically assigned to human actors.

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be expected to comprehend remains problematical.

Certainly courts do not look on such agreements with favor. Consider, for example, State *ex rel.* Gabalac v. Firestone Bank, 346 N.E.2d 326 (Ohio Ct. App. 1975), which involved a $45 check drawn on defendant bank. The payee's bank improperly encoded the amount on the check so that it was read electronically as a check for $10,045, which Firestone Bank incorrectly charged to plaintiff's account. *Id.* at 327. The bank sought to defend its refusal to rectify the overstated debit on the ground that the periodic statements it furnished customers contained a notice that the statement would be assumed correct unless notice of an error was reported to the bank within ten days. *Id.* at 328. While the court recognized a duty on the part of customers to examine bank statements, *id.*, it permitted recovery although notice of the error was not given to the bank for seven and one half months. The court observed that even if notice had been given within the ten day period, it would not have prevented or reduced the loss. *Id.* at 329. *See also* Putnam Rolling Ladder Co. v. Mfr. Hanover Trust Co., 546 N.E.2d 904 (N.Y. 1989) (holding that a bank which had repeatedly paid on forged checks liable notwithstanding the customer's failure to examine its bank statements promptly).

III. "HUMAN ERROR" AND FAULTY DESIGN

A. The Problem

The awkwardness of human interaction with present-day machinery and automated systems is a major source of what is often referred to as "human error."[37] Whether human errors are the result of human incompetence or design flaws in the instrumentation (or both) depends, of course, on the circumstances surrounding the error, such as the cognitive ability of the operator and the clarity of the instrument's interface. Though many human errors are the result of sheer ineptitude, there is growing recognition that operational failures arising in the course of human interaction with technological systems are not invariably a result of human incompetence. Instead, the problems of human-machine interaction often stem from faulty design of the machine; the act or omission identified as legally causative because it precipitated an accident may merely have triggered a latent failure such as a design defect or other organizational shortcoming.

The term "clumsy automation" was coined by E.L. Wiener to denote the role awkward systems often play in provoking human errors in such technologically complicated areas as commercial aviation.[38] Awkward interfaces occasion error by increasing rather than diminishing the cognitive workload of human operators at times when they are preoccupied with other tasks demanding attention. Operational failures often stem from interfaces that are not compatible with the finite cognitive capacity and competence of a technological system's human overseer.

When a deficient outcomes arises because an appropriate intention has been improperly executed rather than because of a defect in the intention itself, the error is characterized as a slip. Prototypical slips with legal ramifications arise when the operator of a motor vehicle

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37. Human error, the U.S. Department of Transportation estimates, causes or contributes to more than 85 percent of all highway accidents. *See* U.S. Dep't. Transp., *Pena Calls National Summit to Study Truck, Bus Safety*, 1995 WL 98150 (news release of March 10, 1995). Similarly, the U.S. Coast Guard reckons that over 80% of marine casualties are attributable to human error and 58% of the tanker accidents that occurred in the United States during 1989 and 1990 resulted from human error. *See* U.S. Dep't. Transp., *Coast Guard Distributes Tests Electronically*, 1993 WL 218920 (news release of June 22, 1993); U.S. Dep't Transp., *Coast Guard Proposes Tanker Bridge Manning Rules*, 1992 WL 366630 (news release of October 1, 1992).

38. *See* EARL L. WIENER, NASA CONTRACTOR REP. 177528, HUMAN FACTORS OF ADVANCED TECHNOLOGY ("GLASS COCKPIT") TRANSPORT AIRCRAFT (1989). *See also* Richard I. Cook et al., *The Natural History of Introducing New Information Technology into a Dynamic High-Risk Environment*, 1990 PROC. HUM. FACTORS SOC'Y 429.

inadvertently presses the accelerator pedal instead of the brake.[39] Action slips are often the result of deficiently designed instrumentation, processes, or procedures.[40] Since so many accidents are engendered by human error rather than mechanical failure, our increasing knowledge about the psychological mechanisms of slips and mistakes should have important implications for tort law.

The legal significance of physiological and psychological factors such as fatigue[41] and accident proneness[42] has long been recognized.[43] Otherwise innocuous slips or lapses may interact with organizational shortcomings and design flaws to bring an accident about or cause an otherwise relatively minor incident to escalate and evolve into disaster. This is especially likely in contemporary technological systems that manage nuclear power plants, launch space vehicles, or operate commercial aircraft by integrating the general intelligence and adaptability of human operators with special-purpose expertise provided by computers.

When human-machine interaction produces injurious outcomes, the relevant question — for both engineers and attorneys — is what behavior by the human operator should count as an error. From the engineer's point of view, the key objectives are to analyze the mechanism of the breakdown and to redesign the interface in an effort to ameliorate the newly recognized peril. Thus, when confronted with a disaster occasioned by a design error, the engineer tends to focus upon gleaning knowledge from the failure rather than ascribing blame.

The way engineers and lawyers routinely describe unsatisfactory outcomes reflect their divergent attitudes, for they really do not speak the same language. Engineers tend to characterize misadventure in blame neutral and non-accusatory terms such as "collapse" or "breakdown" in situations where a lawyer might describe the mishap with such condem-

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39. *See, e.g.*, Foster v. Craig Equip. Co., 550 So. 2d 818 (La. 1989); Hennessey v. Suhl, 333 A.2d 151 (R.I. 1975); Great Am. Indem. Co. v. Dixie Auto Parking & Serv. Corp., 84 So. 2d 233 (La. 1956).

40. *See generally* JAMES REASON, HUMAN ERROR 54-55 (1990).

41. *See* Martin Moore-Ede, *When Things Go Bump in the Night*, 81 A.B.A. J. 56 (1995).

42. Accident proneness theory is based on statistical observations that a disproportionate share of the accidents that occur in society can be attributed to a small number of people. Although the statistical findings have been replicated, many contemporary psychologists reject the theory for its correlative assumption that a greater propensity to be in an accident stems from some personality trait or other characteristic of the individual. Over the years, psychologists have been unsuccessful in their attempts to isolate a clearly definable accident-prone personality. REASON, *supra* note 40, at 198-99.

43. *See generally* Fleming James, Jr. & John J. Dickinson, *Accident Proneness and Accident Law*, 63 HARV. L. REV. 769 (1950).

natory terms as "oversight" and "blunder." The attorney's characteristic stance is apt to provoke the engineer into recriminating: "I'm not interested in assigning blame; I'm interested in fixing problems." Correcting the problems that arise because a system's design has predisposed users to err cannot readily be disentangled from ascribing fault. The unfortunate result is a rampant disregard for the necessity of incorporating inexpensive interlock devices to "idiot-proof" machinery, an oversight that regularly occasions misadventure and liability.[44]

One seldom finds the problem of human-machine interaction treated explicitly in the case law, since courts thus far have endeavored to resolve problems emerging from the assimilation of hazardous technology on a case by case basis without attempting to work out a comprehensive theory. Though the body of case law on cognitive factors in design has not yet arrived at the critical mass necessary for a comprehensive assessment of judicial attitudes towards human-machine interaction, accumulating legal decisions do evince an understanding of the problem and its possible legally-implemented solutions. The few cases that have addressed this problem provide an early glimpse at how the law might constrain designers to modify instrumentation to facilitate accident avoidance.

Before examining the case law, it will be useful to look at a sampling of disastrously faulty interface designs.

B. Some Accidents Occasioned by Faulty Design

Contrivances operated by means of multiple gauges, signal lights, or control levers generate foreseeable human errors because the organization of information displays and controls often does not take cognitive factors into account. Four life-threatening occurrences reported in the *Journal of Cardiothoracic and Vascular Anesthesia* were demonstrated to have been caused by a deficiently designed automated infusion controller,[45] a medical appliance routinely used to administer

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44. *See, e.g.*, John v. Cincinnati, Inc. 36 A.T.L.A. L. Rep. 139 (Mich. Cir. Ct. 1993) (lack of flap on press brake pedal); LeHew v. Mannesmann-DeMag A.G., 35 A.T.L.A. L. Rep. 189 (Pa. Ct. C.P. 1991) (lack of fail-safe device to prevent gate from opening when car carrying molten steel was not in proper position); Kelchner v. John Deere Co., 34 A.T.L.A. L. Rep. 227 (N.Y. Sup. Ct. 1990) (lack of interlock to cut off power to blades when lawn mower was put into reverse); Harris v. Scott Equip. Co., 33 A.T.L.A. L. Rep. 118 (Cal. Super. Ct. 1990) (lack of interlock to cut off power when safety guard was not in place).

45. Richard I. Cook et al., *Unintentional Delivery of Vasoactive Drugs with an Electromechanical Infusion Device*, 6 J. CARDIOTHORACIC & VASCULAR ANESTHESIA 238 (1992).

vasoactive and anti-arrhythmic medication during cardiac procedures. This instrument, intended to reduce the decisionmaking burden of medical specialists preoccupied with the need to make complicated medical assessments within stringent time constraints, has the unanticipated side effect of spawning collateral errors that undermine the specialists' performance. Investigation of critical incidents revealed that "hidden modes of operation, inconsistent signal-action mapping, mislabeling of controls and misleading display messages" compromised the anesthesiologist's ability to render appropriate care.[46]

Tragedies such as the 1979 Three Mile Island disaster and the 1986 *Challenger* catastrophe have captured the public imagination. These technological disasters have intensified feelings that the enormous proficiency of contemporary technology generates unacceptable perils, and that we are losing the ability to keep modern technology within the bounds of human governance and control. In the case of Three Mile Island, the operators who were later said to have "caused" the disaster did not realize that a critical relief valve was stuck in an open position, because their control panel communicated with them about the status of the valve in terms of whether a particular activation switch was on or off. If a user interface is to empower rather than mislead, the pertinent internal operations of the mechanism must be discernible and unambiguous to its users. On the Three Mile Island display panel, the switch that opened and closed a critical valve was in the closed position, but the device that should have responded to the switch and closed the valve had failed. Consequently, the operators never came to consider the possibility that the mechanism controlled by the switch had failed.[47]

When humans are embedded as components of automated technological systems, the notion of operator error may lose its meaning if isolated from the environment in which the failure occurred. If the human role in a computer-based system is downgraded to the point where an operator's function is merely to push buttons in response to signals, technology is operating without effective human supervision. Such systems are more appropriately described as "attended" rather than "operated." It seems inappropriate to ascribe blame or attribute liability to a human operator for an accident that is spawned by a system that is merely "attended."

Many of the seventy-five percent of airline accidents ascribed to pilot error[48] may actually arise on account of defective interface designs, such as airplane cockpit panels that predispose pilots to react improperly.

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46. *Id.* at 240.

47. REASON, *supra* note 40, at 54-55.

48. NORMAN, THINGS THAT MAKE US SMART, *supra* note 6, at 11.

Failure to take human needs into account is demonstrated by cockpit designs that fail to provide a place for the pilot to set down a coffee mug. Indifference to affording pilots common amenities may also manifest itself as a failure to provide a means for the pilot to visually determine whether the landing gear is locked in place — a design flaw at the source of a fatal crash blamed on "pilot error."[49] Tradeoffs are inevitable in every product development process, but the designer of that ill-fated aircraft configured it with a view to accommodating its instrumentation, and the need to adjust those accouterments to the pilot's convenience was entirely overlooked or not considered compelling.

C. Redundancy as an Antidote for Human Error

Redundancy is the term used in this Article to refer to those attributes of machines that, while not directly related to the machines' purpose, are nevertheless necessary to ensure machines are used properly — e.g., to make the machine idiot-proof or to allow the machine to function more effectively as a substitute for a human actor.[50]

Cognitive science research has demonstrated that the human mind conserves resources of attention by relegating a considerable share of its intellectual processes to habitual or programmed behavior. If human error is to be ameliorated, thoughtless and unintentional behavior will have to be taken into account in the design process. Psychological aptitudes such as awareness and the capacity to communicate are indispensable to proper human-machine interaction. Integrating human behavior that is involuntary, in the sense of being ingrained or programmed, with modern technology presents dilemmas that seem almost insurmountable. Industrial designers and human factors practitioners must design warning alarms and control panel indicators that seize the attention of users who are engrossed in incidental tasks as well as those who are inattentive or looking elsewhere. A user's attention cannot be captured and instinctive self-protective behavior evoked unless a machine's signals and controls cohere with mechanisms of human cognition.

Congress has been particularly concerned with the possibility of reconstructing the design of hazardous technologies to reduce the

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49. *See* NORMAN, TURN SIGNALS, *supra* note 6, at 156-57. In response to this problem, the Israeli airline, El Al, announced plans to equip all of its aircraft with cameras that would permit pilots to observe engines and other parts of the aircraft not visible from the cockpit. *See El Al to Use Safety Cameras*, N.Y. TIMES, Oct. 18, 1993, at D2.

50. This latter subject is taken up in part IV, *infra*.

potential for human error. It has imposed on the Administrator of the FAA, for example, a duty to "conduct or supervise research to develop a better understanding of the relationship between human factors and aviation accidents and between human factors and air safety . . . and to identify innovative and effective corrective measures for human errors which adversely affect air safety."[51] Similarly, the Oil Pollution Act of 1990 instructed the U.S. Coast Guard to establish standards for overfill devices on ships and barges that carry oil in order to reduce the possibility an oil spill will occur as a result of human error.[52]

Courts have also become increasingly receptive to the notion that the ambience in which mishaps occur is pivotal.[53] Since negligence refers to behavior that is substandard, inattentiveness is not necessarily coextensive with negligence. People who became distracted in circumstances where similarly situated ordinary prudent persons would also have been preoccupied are not negligent. Instinctive and inadvertent actions, however ill-advised, should not be equated with carelessness.

Accidents that arise from failures to complete a maneuver, activate a needed instrument, or take corrective action are often the result of organizational and design deficiencies. The potential for intervening

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51. 49 U.S.C. § 44505(b) (1994).

52. Oil Pollution Act of 1990, Pub. L. No. 101-380, 104 Stat. 484 (codified in scattered sections of 33 U.S.C.). On January 12, 1993, the Coast Guard proposed a rule that requiring dual-alarm systems to warn of overfills on tankers, and dual-alarm systems, automatic shut-down systems, or stick gauges for tank barges. *See* U.S. Dep't Trans., *U.S. Coast Guard Proposes Rule to Help Prevent Oil Spills*, 1993 WL 11269 (news release of January 12, 1993).

53. See, for example, Conti v. Ford Motor Company, 743 F.2d 195 (3d Cir. 1984), which involved a driver's failure to disengage the clutch of a standard transmission Ford Mustang when he started the car in reverse. This caused a passenger entering the vehicle to lose her balance and fall as the car lurched backward. Plaintiffs attributed their accident to a purported failure to adequately warn the driver that it is dangerous to start a standard transmission in gear with the clutch engaged. They suggested that a "reminder" warning inscribed on the instrument panel would have nudged drivers into awareness and focused their attention on the danger of inadvertently starting in reverse gear without disengaging the clutch. *Id.* at 198. The driver in *Conti* had had many years of experience with standard transmission cars and, indeed, had driven the vehicle in question for nine or ten months without incident. He testified to his knowledge that "driving a standard transmission you would have to depress the clutch." *Id.* The district court had characterized the operator's inattention as "momentary inadvertence" and submitted the issue of causation to a jury that ultimately found that plaintiff's injuries had resulted from a defective design that provided inadequate warning of the danger. The Court of Appeals overturned the judgment because, in its consideration, there was no reason to believe that the driver would have paid greater attention or have been more alert to danger merely because a sticker on the dashboard cautioned him to disengage the clutch. *Id.* at 199.

events or acts to distract an operator's attention exists in all human-machine interactions. A failure to complete intended actions may be induced by the stress of reacting to intervening events that interrupt the operator's thought process. Because much modern technology is used in cognitively fatiguing environments the potential for inadvertent memory failure and compromised situation awareness should be recognized and accounted for in the design of cognitively burdensome operations. To the extent practicable, the procedures of human-machine interactions should be arranged with a view to minimizing the need for collateral actions that might intrude and distract an operator's attention before indispensable antecedent operations are completed. Indicators or warning signals must be deployed to counteract foreseeable distractions.[54]

Donald Norman has classified operator errors into discrete categories on the basis of the cognitive mechanism that is implicated in their generation.[55] The Article now turns to three discrete categories of human error — mode errors, capture errors, and description errors — and how the law can contribute to both understanding and solving these problems.

1. Mode Errors

There is a tendency for technological contrivances to have more functions than they have separately dedicated buttons and controls. Mode errors occur when such a multi-mode interface is overly complex or otherwise inadequate. The error is occasioned by appropriate actions taken in the context of a mistaken perception about the state of system. These errors germinate in systems that do not prevent users from supposing that the instrumentation being operated is in one state when it actually is in another.

The ever-increasing sophistication of our gadgetry is a source of frustration to human users who find themselves incapable of figuring out

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54. *See, e.g.*, Anderson v. Hyster Co., 371 N.E.2d 279 (Ill. App. Ct. 1977), *aff'd.*, 385 N.E.2d 690 (Ill. 1979) (affirming a jury finding of defective design where the directional controls of a forklift truck were unduly confusing). Donald Norman points out that: "In many ways the old saying, out of sight, out of mind, is apt; if a set of operations is interrupted with other activities so that no reminder of them remains visible, the action sequence is apt to be forgotten. A good system design will not let this happen, but will redisplay uncompleted sequences (or unanswered questions) whenever there is a chance that they are no longer visible to the user." Norman, *Design Rules Based on Analyses of Human Error*, *supra* note 17, at 257 (emphasis omitted).

55. *See generally* Norman, *Design Rules Based on Analyses of Human Error*, *supra* note 17.

how to use the numerous features of common appliances. Operation of such familiar devices as digital watches, cameras, and VCRs require people to understand and become proficient at manipulating buttons that function in various modes. The faulty typing that ensues when the command key is struck in place of the shift key is a prevalent mode error. Typewriters and computer keyboards invariably allocate more than one function to particular keys, so that one result occurs when a key is struck independently and another when it is actuated in conjunction with an alternative key. Ordinarily, these difficulties are seen as a matter of amenity that manifests itself in consumer dissatisfaction. But supplanting separately dedicated buttons or switches with a multi-mode input device has precipitated dire consequences. One such incident involved a DC-10 aircraft that stalled in midair, apparently because the pilot had made a mode error in setting the autopilot.[56]

A likelihood of mode error should be anticipated and remedied whenever an apparatus does not provide its operator with conspicuous information regarding its current state. Multiple modes should be avoided whenever possible and their number and complexity should never be unnecessarily increased. Economic or technical considerations may make elimination of multi-mode controls inexpedient in many cases, but the decision to utilize them subsumes a process in which consumer annoyance and heightened potential for error are balanced against the expense or technical degradation necessary to curtail their use. If a user interface is to empower rather than mislead, the pertinent internal operations of the mechanism must be made discernible and unambiguous to users. Problematic outcomes are appropriately ascribed to improper design rather than inattentiveness when the ill-advised action was induced by a misguided belief that the mechanism was operating in one mode when it was actually in another.

The most rudimentary mode errors are spawned by devices that fail to inform an operator that they are active or operational. A defective burglar alarm system that was considered in *Pope v. Rollins Protective Services Co.*[57] illustrates this aspect of the mode error problem. The instrumentation in that case comprised a master control unit, a number of wireless transmitters, an outdoor siren, and a panic button. The transmitters sent an electronic signal to the master control unit to activate the alarm if the panic button was pushed or electronic contacts were

56. *See id.* at 255.
57. 703 F.2d 197 (5th Cir. 1983).

disconnected or moved.[58] A company representative assured the customer that the alarm would actuate if the system's wires were cut by an intruder,[59] but the unfortunate Ms. Pope found out the hard way that her system did not have an independent source of electric power and consequently failed to sound in an emergency.[60] Readers familiar with typical alarm systems used in homes and workplaces might wonder why she was not alerted to the fact that her system had been disarmed by the absence of the high-pitched tone that vociferates until a proprietor enters a code on a key pad or inactivates the signal with a key. The reason Ms. Pope was not alerted by absence of the high pitched tone when she opened her door was that "the same thing had happened a month before because of low batteries for the transmitter on her back door."[61]

This failure of communication was particularly egregious, for the siren song (or lack thereof) actively enticed the victim into her home at a time of danger. An appropriately designed system would not befuddle its user by associating a low battery signal with the warning generated by a criminal's attempt to circumvent the alarm. The court sustained a $150,000 award for mental anguish, because disarming the alarm by cutting exposed wires at the master control unit was a stratagem the victim had been assured her system was designed to defeat.[62]

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58. The first alarm, which sounded immediately, was a high-pitched tone called Sonalert, which could be heard inside but not outside. The second alarm was a loud separate siren outside the house that sounded for a period of ten minutes. Finally, the master control unit would automatically dial Rollins's "central station," giving the name and location of the residence. *See id.* at 199.

59. This assurance was given in response to Ms. Pope's concerns regarding the placement of the system wires. At the time the system was installed, she noticed that the wires running from the master control unit were installed outside the sheetrock wall in her broom closet and were visible when the door to the closet was open. *See id.*

60. Failure to provide a redundant source of electricity is a common design deficiency. Consider, for example, elevator telephonic systems that lack a redundant source of electricity to enable persons stranded inside to call for help and report their location when electrical power is lost due to a fire.

61. *Rollins*, 703 F.2d at 200.

62. *But see* Ressallat v. Burglar & Fire Alarms, Inc., 606 N.E.2d 1001 (Ohio Ct. App. 1992). In that case, phone cables were not reburied in the ground after repair of the alarm system. Thus, burglars could gain unimpeded access to the property by cutting the exposed wires and preventing the alarm from being transmitted to the alarm company. The court, however, held for the defendant on the grounds that there was no assumed duty to rebury the telephone wires. Similarly, in Helm v. KOG Alarm Co., 5 Cal. Rptr. 2d 615 (Ct. App. 1992), a homeowner was erroneously told that severing the phone wire would notify the alarm company of a break-in. Because the court felt that plaintiff had failed to show a cause-in-fact relationship, defendant was not held liable for the resulting loss. Although these courts held for the alarm companies, it is clear that human interference with the alarm was insufficiently thought through in the design of the system. This category of inadequacy is fundamental because of the expectation that

2. Capture Errors

Another class of slips, the capture error, springs from mistakes in performing perfunctory actions, motions, or operations that produce results different from those originally intended. These errors are almost always precipitated by a lack of cohesion and continuity in system procedures.[63]

Human memory is inherently limited and imperfect; it is composed of imprecise and fragmentary representations of the things with which humans interact and the operations they execute.[64] The incomplete descriptions of objects people learn to recognize and actions they train themselves to perform are usually sufficient to enable the machinery of their minds to achieve satisfactory outcomes in the vast majority of cases. In exceptional instances the atypical experience may be processed inappropriately. Donald Norman relates an anecdote in which a person "cleaning a fish in a rowboat in the middle of a lake[] threw the cleaned fish overboard and kept the entrails."[65] Such errors are legally significant: activating the wrong valve or lever,[66] pressing the wrong button,[67] or engaging the accelerator instead of applying the brake[68] often occasion serious accidents.

Because the knowledge and memory humans allocate to interaction with machinery frequently is imprecise and fragmentary, the tendency of operators is to compensate for an incomplete mastery of operational details through an analogy to features about which they are knowledgeable. Users will be confounded and likely to generate error whenever a system's procedures are structured inconsistently or are otherwise counterintuitive. Systems in which similar sequences of acts cause antithetical outcomes are not uncommon. When one of these sequences

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alarm systems will be tampered with.

63. Donald Norman describes this inducement to error as a "lack of consistency in command structure, so that the appropriate structure for one command is not the same for another, even though the commands appear to be related and share a common description of purpose action, and even part of the command format. Similar situations occur in the interpretation of instrument readings." Norman, *Design Rules Based on Analyses of Human Error*, *supra* note 17, at 256.

64. *See generally* NORMAN, THE DESIGN OF EVERYDAY THINGS, *supra* note 6, at 54-80.

65. *See* Norman, *Design Rules Based on Analyses of Human Error*, *supra* note 17, at 255.

66. *See, e.g.*, Leggette v. J.D. McCotter, Inc., 144 S.E.2d 849 (N.C. 1965).

67. *See, e.g.*, Di Bernardo v. Star-Kist Foods, Inc., 10 Cal. Rptr. 209 (Ct. App. 1960).

68. *See, e.g.*, Jones v. Western Preferred Casualty Co., 633 So. 2d 667 (La. Ct. App. 1993).

is called for time and again while the other is performed only occasionally, a person attempting the exceptional operation may by force of habit execute the usual one. Inauspicious habituated actions induced by internally incoherent procedures should be ascribed to inexpedient design.

The courts have not consistently embraced this view. Consider *Great American Indemnity Co. v. Dixie Auto Parking and Service Corp.*,[69] an action brought against the operator of a parking lot whose attendant crashed a customer's car while attempting to park when he confused the car's accelerator with a clutch pedal. It has become conventional for accelerator pedals to be situated to the right of the brake on almost all vehicles. The automobile in question was equipped with an automatic transmission but its accelerator was located to left of the brake. The attendant therefore assumed he was driving a standard shift vehicle and that the accelerator was actually a clutch pedal.[70] The court attributed the accident exclusively to operator negligence:

> [Defendant] McKnight has had thirty years' experience in driving automobiles and has been a parking lot attendant for several years. We think that because of such long experience with automobiles, he should have noticed at a glance that the automobile was not equipped with standard transmission, and why he reached for the clutch is beyond us. If after starting the motor and setting the indicator at the desired forward gear, McKnight had used prudence in locating and depressing the accelerator instead of attempting to operate the car by reflex action no matter on which

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69. 84 So. 2d 233 (La. Ct. App. 1956). *See also* Hennessey v. Suhl, 333 A.2d 151 (R.I. 1975). That case was an action for personal injuries sustained when an automobile lurched forward and struck the plaintiff after the driver depressed the accelerator instead of the brake. Defendant had driven a 1960 Citroen to a carwash at which plaintiff was an employee, whereupon another employee had driven it through the carwash. This latter employee testified that on entering the car he realized that he had never before driven a Citroen but nevertheless did not check the brakes before starting through the carwash. When he attempted to stop the car, he mistook the brake pedal for a dimmer switch and hit the accelerator instead. *Id.* at 312. The Citroen's brake pedal, which is situated to the left of the accelerator, is a circular disc an inch and a half in diameter located about one inch from the floor. Plaintiff contended that the unusual nature of this braking device rendered the Citroen sufficiently dangerous to impose upon the defendant the duty to warn the carwash attendant. *Id.* at 313. The Rhode Island Supreme Court held that defendant, as a reasonably prudent man to whom the foreign car had been lent, should not have foreseen that the unusual construction and location of the brake pedal on the car would, when the car was delivered to an attendant at a carwash, constitute a dangerous condition and was therefore not obligated to warn the attendant. *Id.* at 314.

70. *Great Am. Indem.*, 84 So.2d at 234.

> side of the brake pedal the accelerator was located, the car would not have moved as rapidly forward as it did. There is no question that McKnight was negligent under the circumstances and the defendant must respond therefor.[71]

Many courts, however, have come to realize that conventional paradigms of carelessness are inapplicable to conduct controlled by subconscious mechanisms. The reality of the human condition led another court to conclude: "The fact that as an abstract proposition a person learning to drive knows the difference between the accelerator and the brake does not indicate negligence if he misuses these controls in an emergency."[72]

3. Description Errors

Description errors occur when controls or warning signals do not accommodate the ineptitude or cognitive limitations of a human actor. If buttons, switches, or pedals that control a mechanism, or dials or displays that provide timely information about a machine's internal state, are not sufficiently differentiated, operators may become flustered and prone to missteps.

The confusion brought about by disorganized instrumentation often generates an unintended action. *Ericksen v. Salt Lake City Corp.*[73] involved an accident in a facility with fourteen large garage-type overhead doors operated by electric controls. A construction inspector inadvertently pressed the wrong button while attempting to open one door and raised another instead which, in turn, caused the fall of another worker stationed on a ladder positioned against the unwittingly opened door.[74] Control panels configured to accommodate an overly complex technology or design aesthetic at the expense of human cognitive capability increase the likelihood the user may become befuddled and

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71. *Id.* at 235.

72. Richards v. Richards, 324 S.W.2d 400, 402 (Ky. 1959).

73. 858 P.2d 995 (Utah 1993).

74. See also Wiese v. Rainville, 343 P.2d 643 (Cal. Ct. App. 1959), in which a manufacturer's representative invited the plaintiff to assist in a demonstration of a packaging machine:

> Rainville asked if plaintiff was ready; plaintiff asked if Rainville was sure the machine was set in the proper manner for that operation; he replied in the affirmative; plaintiff said he was ready; then Rainville, who was standing at the right side of plaintiff, pushed the wrong button, and the clamping frame came down on plaintiff's hand; plaintiff called for help; Rainville said, "Oh, my God, what have I done now?"

Id. at 647.

react inappropriately. These pitfalls are exacerbated when users are expected to react to information gleaned from a fleeting glance at instrumentation situated in the periphery of their vision.

The intuitive interfaces utilized by present-day personal computers demonstrate that designs drawing upon familiar images can drastically reduce the incidence of action slips.[75] If description errors are to be avoided, the knobs, buttons, switches, warning-indicator lights, meters, and other interface components should be configured in functional patterns. Heterogeneous controls must not only look and feel different from one another, but must also dovetail with the mechanism of human mentality. Controls used to send a vehicle in a particular direction should correspond to a similarly-directed movement of the control.[76] Because growing knowledge of the mechanism of cognition makes it practicable to design latent human error out of technology, we should expect that the law will constrain design. An evolving legal doctrine of redundancy compels intervention with safety devices and other countermeasures to counteract foreseeable slips and errors.[77]

IV. THE DISPLACEMENT OF HUMAN ATTRIBUTES BY AUTOMATED PROCESSES: MACHINES AS SUBSTITUTES FOR HUMAN ACTORS

The replacement of humans by machines is acceierating. We are witnessing growth in the use of unattended machinery in virtually every activity of daily life. It has become part of our common experience that we interact with machines as co-workers, bankers, teachers, and even physicians. Transactions with increasingly sophisticated machines that react in ways we might expect people to behave foreshadow an age of fully intellectual machinery. Automated computer-based systems raise the legal and design issue of the extent to which mechanical analogues for prototypical human attributes must be embodied in unattended machinery.

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75. *See supra* note 19.

76. In Anderson v. Hyster Co., 371 N.E.2d 279 (Ill. App. Ct. 1977), *aff'd.*, 385 N.E.2d 690 (Ill. 1979), an incongruous relationship between control pedal movements and the motion of a lift truck was critical to the court's affirming a jury finding that the vehicle in question was defectively designed. That court's attention was called to standards promulgated by the Society of Automotive Engineers, which provide in pertinent part: "If a foot-actuated directional and variable speed control is provided, two pedals shall be used. Forward or downward motion on the outer pedal shall produce reverse motion and forward or downward motion on the inner pedal shall produce forward motion." *Id.* at 282.

77. Uloth v. City Tank Corp., 384 N.E.2d 1188, 1192 (Mass. 1978).

It is not uncommon for unattended machinery to become a full-fledged participant in legally significant transactions. The analytical significance of whether a mechanical stand-in provides a satisfactory substitute for the displaced human function or participant is illustrated by a review of decisions that touch upon this aspect of the automation process. While this approach is of little use in assessing the designs of more mundane products such as doors, light switches, and others that are the subjects of Norman's *The Design of Everyday Things*, it is a useful vantage point from which to evaluate more interesting and problematic complex systems, such as those discussed in *Turn Signals Are the Facial Expressions of Automobiles* and *Things That Make Us Smart: Defending Human Attributes in the Age of the Machine*. Posing the question of whether displacement of a human capability by a mechanical expedient is legally acceptable focuses our attention on design inadequacies. These design inadequacies, in turn, affect the extent to which liability is engendered by automation.

I have used the term "redundancy" to describe the inclusion in interface design of factors necessary for the protection of the public. This constraint often imposes manual or other inefficient routines on automated systems. One court has suggested, for example, that automated bank tellers should be equipped with cameras that videotape transactions.[78] Videotaping is not needed to improve the mechanical proficiency of the unattended teller; rather, it is needed to protect the banking consumer from occasional malfunctions or criminality. Likewise, a cigarette vending machine is perfectly capable of dispensing its wares quickly and efficiently, without components that provide mechanical analogues for human judgment or memory. Automated sales accomplished by use of such vending machines have been outlawed, however, because such capacities are lacking.[79]

An analysis of pertinent decisions dealing with human-machine interaction reveals the indistinct outlines of legal principles governing the displacement of human activity by machines. Trends inherent in these decisions have been only dimly apprehended, for courts resolve specific problems as they emerge without attempting to work out an overarching theory. In general, the courts have embraced the idea that machines should be accommodated to human needs and that humans ought not be required to conform to mechanical convenience.[80] In applying these concepts to problems engendered by our interactions with

78. McEvans v. Citibank, 408 N.Y.S.2d 870, 872 (Civ. Ct. 1978).

79. These examples are explored further below. *See infra* text accompanying notes 83, 100-104.

80. Allen v. Beneficial Fin. Co., 531 F.2d 797, 802 (7th Cir. 1976).

machinery, courts balance the efficiencies achieved by mechanization against the hazards produced. When they impose liability in this class of cases and regulate the level of competence demanded of automated facilities, courts essentially mandate design specifications.

A. Which Human Attributes Must Automation Possess?

We begin with a typical example of an abominably designed interface. Donald Norman claims to have seen people become emotionally upset as a result of their interactions with a stamp vending machine at his local post office.[81]

> The machine at my post office in Del Mar, California, not only had hand-lettered signs on it but a fancy computer-controlled sign with scrolling red letters that said: "Welcome to the Del Mar Post Office Vending Machine — I refund a maximum of $3.25 change with your purchase. — Think before depositing a bill larger than $5 —." Now put yourself in the place of a postal patron who has just inserted $30.00 in order to purchase a roll of one hundred 29-cent stamps, expecting to get the stamps and $1.00 in change. But then, after the machine has graciously accepted the money, it informs you that it no longer has any of those rolls: What would you like to buy instead? And, no, it can't simply return your $30.00 (it returns no more than $3.25, remember).[82]

The stamp machine illustrates a multitude of interface deficits, not the least of which is a boorish demeanor. The mechanical postal clerk seems to be saying: "Put in the money, say what is wanted, and no back talk." Changes suggested to enable the vending machine to comport itself with a modicum of courtesy include permitting users to make a selection before they deposit money, reconfiguring the machine to request the purchase price only after communicating to the customer that the desired item is in stock, and installing a button marked "cancel sale" so that any money deposited could be returned at the customer's option prior to delivery of the goods. Norman's discussion of design deficiencies and suggested solutions, however, relate to matters of amenity and do not explicitly address the rights and duties of parties to the transaction.

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81. NORMAN, TURN SIGNALS, *supra* note 6, at 34.
82. NORMAN, THINGS THAT MAKE US SMART, *supra* note 4, at 237-38.

The attributes that automated devices such as the stamp machine must possess in order to fill in effectively for human actors can be loosely grouped into three categories, which I call judgment, recountability, and civility. The first factor, judgment, is illustrated well by a recent attempt at a solution to this conundrum — the development of a mechanical "bartender" equipped with surveillance cameras that enable a human to monitor each sale and insure that a purchaser is sober and of legal age.[83]

The second factor, recountability, describes the human capacity for noting the circumstances of a controversy. Consider the unlikely example of a coin-operated gun dealer. Society depends on the good judgment of human gun dealers to sell their wares only to sane adults without criminal records. Because a gun vending machine cannot exercise such judgment, however, it sells to anyone with the appropriate change. This gun vendor is woefully inadequate for its task. There is an additional reason why the machine is an inappropriate gun vendor: unlike its human counterpart, the machine can give no account of the transaction or description of the purchaser and of the gun sold. The vending machine has no eyes, no memory, and no descriptive powers: it lacks recountability. A lack of recountability in unattended systems often gives rise to legal complications, which will be explored below.

The last factor, civility, is perhaps the most elusive of the three to define. In its most basic sense, it is the human response to the needs of other human beings. It is courtesy, compassion, human contact, and interaction. The gun vending machine will never ask one how one's children are, offer advice as to the appropriate caliber for one's needs, or throw in that extra carton of shells for the holidays.[84] Machines that greet their customers are everywhere, but they provide an implausible approximation of a human greeting. The affable automatic teller machine may ask us how we are, but will not be sympathetic if we have had a bad day.

The stamp vending machine's interface demonstrates that civility has been readily sacrificed in machines constructed to stand in for people. As transactions with machines multiply and our daily activities bring us into continual contact with automated facilities, we tend to

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83. See *A Bartender with Buttons Serves Brew to Go*, N.Y. TIMES, July 8, 1993, at D1, which reports that 28 states, the U.S. Virgin Islands, and the Canadian province of Alberta sanction the use of coinless vending machines when an attendant is present; fourteen jurisdictions would permit the sale of legally controlled products such as alcoholic beverages by a vending machine equipped for surveillance.

84. There is, of course, another side to this observation: the machine will never tell one about its children or try to sell one a bigger gun than one really needs; nor will it ever fight with its spouse and visit its frustration on the customer.

ignore the depersonalization thereby engendered. Reluctant acceptance of this lack of civility in automated machinery breeds a certain resignation. While we would not imagine that vending guns by machine could ever be tolerated because machines lack the requisite mechanical analogues for judgment and recountability, we nonetheless resign ourselves to accepting the sacrifice of civility to automated machinery. Those who feel cheated by this deficiency are encouraged to repress disappointment and instead look to the increased economy and expedience of an automated environment.

This evident lack of judgment, recountability, and civility on the part of familiar devices raises a host of difficult questions. Should judges take civility into consideration when they adjudicate cases involving human-machine substitutions? Is it possible to program mechanical analogues for civility on a machine? In what circumstances ought the law require that civility be designed into the interface of unattended facilities or computer-based systems?

By way of addressing these questions, we proceed to a discussion of these three factors — judgment, recountability, and civility — which have become the criteria by which courts have gauged the interfaces of interactive machinery to determine when such unattended facilities are acceptable stand-ins for people.

1. Judgment and Common Sense

When we assess the displacement of human functions by machines in contemporary society, it should not be supposed that human behavior is antithetical to mechanical activity. Can it any longer be doubted that machines and humans emulate each other when mechanical vending devices bid their customers good morning, and people write letters to a computer that duns them for a debt already satisfied? When the enraged owner of a defective automobile douses the lemon with gasoline and torches it, how much of this is demonstration and how much is punishment?

Our analysis of judgment and common sense begins at the point where human and machine have the most in common. Humans are quite capable of performing purely mechanical functions, yet machines seem incapable of performing anything but mechanical functions. We tend to label a task mechanical when the assignment does not require an exercise of judgment except in the most unusual circumstances. The difference between people and machines engaged in mechanical tasks is that, should the exercise of judgment become necessary, persons are assumed to be capable of acting appropriately.

Consider contemporary packaging machinery which displaces human workers in factories. If an insect should stumble into the bin of a packaging machine dispensing a product into containers, we would expect the machine to package the insect along with the product and suppose a human worker might be more vigilant. The likelihood that a human worker will be called upon to exercise judgment in such an eventuality is quite small, and the increase in productivity made possible by automated machinery is tremendous. But technology exists that would allow the judgment a human worker could bring to bear on such tasks to be programmed on a machine. Subject to technological and economic limitations, machines can and do make "decisions."[85]

Humans exercise judgment in all facets of their lives. To some degree, the law shapes an individual's judgment, provides guidance in a variety of circumstances, and codifies what is deemed an appropriate exercise of judgment in various situations. We do not rely on personal criteria in exercising judgment in many instances. If the law considers it essential that ingredients be listed on pharmaceutical products, drug companies have no choice but to adhere to that requirement. The law affords standards and safeguards that permit people to live and work together with a minimum of conflict. In the many areas in which courts and legislatures have not spoken, however, people must look to their reason and sense for guidance. In circumstances where the law has been silent and a person's decisions detrimentally impact on others, it is likely that litigation will ensue that will, in turn, result in judicial decisions approving or disapproving the exercise of judgment in issue.

As we approach the twenty-first century, the state of automated technology has advanced to the point where courts have come to demand an interface design that provides a measure of safety and security. Consider the failure in judgment exhibited by automated machinery in

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85. Christopher Evans has proposed a benchmark for the mechanical analogue for judgment which he denominates the "Carmichael's Hat Test." In the classic British movie *I'm All Right Jack*, Ian Carmichael visits an automated candy factory and is repelled at the sight of a conveyor belt carrying toffee through a tunnel where it is coated with chocolate and capped with a cherry. A bowler hat, accidentally placed on the conveyor belt emerges from the tunnel coated with chocolate and decorated with an array of cherries. Although the machine has not detected that Carmichael's hat is not a piece of toffee, it has exercised sufficient judgment to decorate the hat appropriately. It has not merely covered a portion of the hat approximating the size of a toffee bar, nor plopped only one cherry on the top. Instead, it has gracefully coated the entire bowler hat with chocolate and artistically arranged several cherries around the top. The machine must be endowed with a capacity for aesthetic appreciation and equipped with a size-monitor and a shape-detector. It is, in Mr. Evans's words, "a rather smart robot"! CHRISTOPHER EVANS, THE MICRO MILLENNIUM 146-47 (1979).

Ellish v. Airport Parking Co.[86] Ms. Ellish had driven her car into the enclosure of an airport parking facility after removing a ticket from an automated machine stationed at the entrance. Removing the ticket from the machine activated a gate which permitted her to enter the lot. Once inside, the vehicle was able to exit only through another gate that was attended by a human employee who required surrender of the ticket. If a driver seeking to exit was unable to produce a ticket, the attendants would not release the automobile without some proof that the driver owned the vehicle. When Ms. Ellish returned for her car, however, she found that it had been stolen from the lot. Though the circumstances of the theft were unknown, it is likely that the machine stationed at the entrance had dispensed a ticket to a larcenist pedestrian who had paid a parking fee to the gate attendant and then absconded with her vehicle.[87] The machine controlling entry into the lot was not designed to discern whether the person who removed the ticket had brought a car into the lot. Unmindful of whether vehicles were being driven into the lot, it carelessly dispensed tickets to any passersby.

Circumstances called for prudence on the automatic gate's part, but the mechanism's design was woefully inadequate for the task.[88] Nevertheless, a majority of the court held that the flawed gate did not create an unreasonable hazard, although it did facilitate removal of the victim's automobile by a thief.[89] Case law on the precise point is scanty because *Ellish*-type machines (known as "ticket-spitters") have been supplanted by gate systems that do not dispense a ticket unless a car is

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86. 345 N.Y.S.2d 650 (App. Div. 1973), *aff'd*, 359 N.Y.S.2d 280 (1974).

87. *See* Ellish v. Airport Parking Co., 321 N.Y.S.2d 635, 639 (Civ. Ct. 1971).

88. The larcenist's stratagem is explained in Makower v. Kinney Sys., 318 N.Y.S.2d 515 (Civ. Ct. 1971), as follows:

> It is true that the use of a machine instead of an attendant to hand out tickets adds a little spice to the situation. It creates the possibility that the person presenting himself at the exit may be driving a different car than the one in which he entered, or, indeed, if he is clever and of a more larcenous bent of mind, he may even have come in afoot. The use of the machine, however, is not dictated for the convenience of the customers. It is dictated rather by the desire to obtain the savings in manpower made possible by modern technology. It is a calculated risk the operator is taking. But just because it makes later theft easier does not affect the question of whether a bailment is created when a car enters the lot.

Id. at 518.

89. *Ellish*, 345 N.Y.S.2d at 652. Justice Shapiro remonstrated in dissent that displacement of human parking lot attendants by automated facilities effected an unwarranted diminution of liability and shifted the risk of loss from the proprietor to the customer. *See Ellish*, 345 N.Y.S.2d at 657-58 (Shapiro, J., dissenting).

driven into the lot — a design technique termed a "forced function."[90] Gate systems utilized in contemporary automated parking facilities are more "competent" in the sense that they exercise an element of judgment that make them more proficient than ticket-spitters. This evolution of the technology in commonly utilized automated parking facilities suggests that machinery must exercise as much judgment as the "best available technology" will permit.[91] As advances in available technologies unfold, courts are coming to demand that unattended systems be designed with a deep-seated capacity to interact competently with humans: "If the computer does not think like a man, it is man's fault."[92]

2. Recountability

Evidentiary dilemmas occasioned by the inability of machinery to relate events occurring during the course of an unattended transaction have often been decisive on questions of liability. *Marsh v. American Locker Co.*[93] involved a package worth over $2,000 allegedly pilfered from a coin-operated locker. The owner of the missing parcel claimed that by inserting the appropriate coins, placing the package into the defendant's locker, and removing the key, he had brought a bailment

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90. Donald Norman provides an example of the forced function design technique:

> In some public rest rooms there's a package shelf inconveniently placed on the wall just behind the cubicle door, held in a vertical position by a spring. You lower the shelf to a horizontal position, and the weight of the package keeps it there. Why not provide a permanent shelf always horizontal, placed so that it wouldn't interfere with the opening of the door? There is room. A little thought reveals the answer: the shelf's position is a forcing function. When the shelf is lowered, it blocks the door. So to get out of the cubicle, you have to remove whatever is on the shelf and raise it out of your way. And that forces you to remember your packages."

NORMAN, THE DESIGN OF EVERYDAY THINGS, *supra* note 6, at 137.

The legal significance of this design principle is illustrated by Virginia D. v. Madesco Inv. Corp., 648 S.W.2d 881 (Miss. 1983), which involved a restaurant patron who had been sexually molested by a male intruder in a ladies' rest room. She offered the testimony of a security expert who criticized the fact that doors on the toilet's cubicles did not remain open when the facilities were not in use so as to allow a woman entering the rest room to see if any were occupied.

91. Contemporary ticket dispensers are not "foolproof," as a criminal could drive a stolen vehicle into an automated lot, abandon the car with which he has obtained entry, and use the ticket to purloin a more valuable vehicle. Nevertheless, use of the contemporary, more sophisticated automated gate curtails the risk of thievery.

92. State Farm Mut. Auto. Ins. Co. v. Bockhorst, 453 F.2d 533, 537 (10th Cir. 1972).

93. 72 A.2d 343 (N.J. Super. Ct. 1950).

into being.[94] There was, however, no human agency in *Marsh*: the package had been delivered to an insensate locker and only the person employing the receptacle knew what, if anything, had been deposited. Unscrupulous people might fabricate a claim that they had stored $2,000 worth of merchandise in such lockers. Since receptacles lacking recountability are inherently incapable of refuting such claims, classifying unattended locker transactions as bailments would leave the proprietors of such facilities defenseless.

Instead of imposing liability by regarding mechanical checkroom attendants as functionally equivalent to human bailees, the court ruled that proprietors of mechanical checkroom facilities are not liable for professed losses.[95] In thus circumscribing the legal obligations accompanying mechanization, the *Marsh* court recognized that it was approving and encouraging replacement of human checkroom attendants by automated facilities. Reduction in the quantum of liability was considered reasonable considering the minimal charge at which the service was offered to the public. An unarticulated premise of the decision is that the locker employed the best then available technology, and that it was not feasible to endow these receptacles with a capacity for recountability. This state of affairs was crucial to the court's finding that the automated checking facility performed reasonably in the circumstances. It should not escape our notice, however, that apart from the question of whether the transaction should be characterized as a bailment or a lease of space, the court could have predicated liability upon an estimation that a machine had improperly been employed to stand in for a human to perform tasks for which it was not entirely suited.

The lack of recountability has occasioned similar difficulties in safe deposit bailments. It is the party renting the box, not the bank, who knows what, if anything, has been placed within it. Prominent among the reasons people use a safe deposit facility is to conceal their affairs from others, including the bank. An unscrupulous customer might falsely allege that merchandise worth $10,000 stored in a safe deposit box has disappeared. Categorizing safe deposit transactions as bailments exposes banks to fraud in circumstances where they lack knowledge of the facts that would enable them to refute spurious claims.

In one case involving an unexplained loss from a safe deposit box, *Veihelmann v. Manufacturers Safe Deposit Co.*,[96] the New York Court of Appeals concluded that a bank could be held liable in negligence for

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94. Liability for theft or loss attaches in conventional bailment transactions because a human bailee assumes responsibility for the item.

95. *See Marsh*, 72 A.2d at 346.

96. 104 N.E.2d 888 (N.Y. 1952).

goods merely alleged to have been deposited in the box.[97] This holding, that an unexplained loss in a safe deposit facility raises an issue for the jury, suggests a failure to appreciate the reality of the difference between a human bailee's and a machine's capacity to provide an account of transactions in which it has participated.[98]

Machines empowered to record what, if anything, is placed in them are within the capability of current technology. As the cost of recountability technology declines, recording devices will come to be required for the protection of both the proprietor and the customers of an unattended facility. That the teaching of *The T. J. Hooper*[99] may require recountability to be designed into unattended facilities is illustrated by *McEvans v. Citibank*.[100] Audrey McEvans placed $600 in an envelope, inserted her bank card into Citibank automated teller machine ("ATM"), punched the appropriate buttons, and waited in vain for the machine to proffer a receipt; the component of the machine which generated receipts was not functioning on the day in question. Five days later, Ms. McEvans attempted to make a cash withdrawal from the bank, and was informed by the ATM that her account was overdrawn. Since there was no point in trying to discuss this matter with the machine, Ms. McEvans made a personal inquiry at the bank. A human bank officer maintained that the deposit envelope contained not $600, but only $350; something had gone wrong somewhere.[101]

Ultimately, judgment for Ms. McEvans hinged on its finding that Citibank had failed to follow its own procedures, which required that envelopes deposited in its ATMs be opened in the presence of two employees as a safeguard against fraud. The most telling part of Judge Nardelli's decision is the following observation:

> [T]he bank could have better protected itself and more importantly, its customer, by [using] some form of recording surveillance device in the teller's cage which could, at a later time, show and corroborate every step of the transaction from the opening of the lock box and the unsealing of the envelopes to the making of the actual count and crediting of the account. It seems incongruous that a device so

97. *See id.* at 890.

98. Compare Henderick v. Uptown Safe Deposit Co., 159 N.E.2d 58 (Ill. App. Ct. 1959), a case where nothing but the testimony of the plaintiff and her daughter substantiated a claimed loss of $37,750 from their safe deposit box. The court held that the claim was insufficient to raise a jury question. *Id.* at 65-66.

99. 60 F.2d 737 (2d Cir. 1932). *See supra* note 25.

100. 408 N.Y.S.2d 870 (Civ. Ct. 1978).

101. *Id.* at 871.

> successfully used by the bank to identify and apprehend bank robbers cannot also be used to protect the bank from possible employee thefts or depositors' dishonest claims.[102]

This explanation highlights the central question of whether an automated substitute is sufficient to provide a functional equivalent of a human actor. It also indicates that courts will require that appropriate mechanical analogues of essential human capabilities be included in the interface design of an unattended facility. Indeed, it has now become obligatory in the banking industry to endow ATMs with recountability.[103] Correspondingly, in litigation brought by New York's Attorney General against Citibank that resulted in a redesign of the bank's automated teller machine interface, the petition alleged that the defendant had failed to employ the best available technology as indicated by the fact that automated teller machines in use at other banks utilized cameras to videotape each transaction as a preventive measure.[104]

Automated facilities may come to be endowed with a superhuman degree of recountability. Consider the building at 17 State Street in downtown Manhattan, which is monitored continuously by fifty concealed video cameras. Whenever a theft or other crime occurs on or about the premises, the building's management scrutinizes the electromagnetic memory of its video-cassette recorders for information and displays the video tape on a monitor in the building's lobby under the slogan, "Do You Know This Man?"[105] Similarly, electronic access devices vastly outstrip the capabilities of human security guards in this respect. As Thomas Callen, a marketing manager for Rusco Electronic Systems, points out:

> "If you have 200 people arriving at an office between ten before and ten after eight o'clock, a guard is not going to be able to compare every individual with an ID badge or get a chance to know every individual. In most cases where a large number of people are entering or leaving the building at once, a single guard or even two guards can't be effective. An electronic access device can record all these

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102. *Id.* at 870, 872.

103. *See* BANK ADMINISTRATION INSTITUTION TASK FORCE ON ATM CRIME, ATM SECURITY HANDBOOK 69 (2d ed. 1988).

104. Affidavit of Assistant Attorney General Stephen Mindell, at ¶ 15, New York v. Citibank, 537 F. Supp. 1192 (S.D.N.Y. 1982) (No. 81-7273). *See infra* notes 131-39 and accompanying text.

105. *See Commercial Property: Security Systems*, N.Y. TIMES, July 9, 1989, § 10, at 19.

> comings and goings into a computer, store them in memory, then selectively go back and retrieve them."[106]

We have arrived at a point where existing technology is capable of providing unattended equipment with an indigenous capacity for recountability. As this technology advances to a stage where it becomes more affordable and easily installed, extensive capabilities for recountability may become a basic feature of commonplace unattended systems.

The effort to increase efficiency through further automation exacts a social cost. Because those exposed to perils engendered by automated facilities are not represented in the design process, the embedding of humane attributes in automated systems to protect the public should not be viewed as a mere amenity. We may expect that humane constraints will increasingly be mandated on a case by case basis as courts are called upon to determine the extent to which automated processes that tamper with the quality of our lives should be tolerated.

3. Civility

One aspect of civility that is a component of automated courtesy is intercommunication.[107] At a minimum, civility demands that the machine's operations be intelligible and unambiguous from the standpoint of the user, and that the interface assist rather than manipulate the user. Any propensity for deception generated in the process of automation ought to be eliminated or minimized. A capability for meaningful communication with users is a prerequisite to the adequacy of any system which deals with people.[108]

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106. Kellyn Betts, *Electronic Access Controls Always Alert*, MOD. OFF. TECH., June 1986, at 108; *see also* Nussbaum & Neff, *supra* note 23, at 84.

107. As commonplace machinery comes to rely on electronic circuitry to an ever-increasing degree, we make our intentions and needs known to the ubiquitous appliances of the everyday world by means of "pushbuttons." Seemingly simple buttons used on everything from telephones to toys may cost as much as $50,000 to $60,000 to design. The Product Assurance Manager for Hewlett-Packard explained: "'We've tried to maintain the tactile sensation. With a smooth surface you never know if you've got anything on the screen unless you look. We've also found that customers appreciate if the button makes a little noise, registers the contact. It may sound a little silly but it makes the pushbutton more human.'" *A Nation of Button Pushers*, N.Y. TIMES, Jan. 25, 1981, § 3, at 19.

108. *See, e.g.*, Allen v. Beneficial Fin. Co., 531 F.2d 797 (7th Cir. 1976); Brunett v. Westminster Bank, [1965] 3 All E.R. 81 (Q.B.). Donald Norman articulates this idea as follows: "As I study the interaction of people and technology, I am not happy with what I see. In some sense, you might say, my goal is to socialize technology. Right now, technology lacks social graces. The machine sits there, placid, demanding. It tends to

Even where the participation of a human is not essential to the efficacy of a routine performance, a human must ultimately bear responsibility when automated expedients fail to perform adequately. In *Palmer v. Columbia Gas, Inc.*,[109] for example, a court condemned a gas company's computerized billing system and ordered that an automated procedure for terminating service be rehumanized. The gas company's customers often received a succession of computer generated estimated bills followed sporadically by a bill based on an actual meter reading in an amount many times higher than the estimated ones. A notice accompanying these disproportionately higher statements would announce the computer's intention to discontinue service if full payment of the outstanding balance was not received within ten days. All efforts to explain the hardship and distress this infernal procedure inflicted upon consumers failed. The company's executives proved so indifferent that it seemed to the court that day-to-day operations of the company were being usurped by the computer-based system. The court refused to tolerate this want of civility so detrimentally affecting the lives of thousands of consumers. It ordered the gas company to interpose human intermediaries who were empowered to take a more responsive and accommodating attitude with customers seeking a billing adjustment.[110]

There are numerous circumstances in which consumers lack sufficient credibility to dispute machine-generated information[111] and find themselves unable to locate a human with sufficient authority to intervene on their behalf. Automated systems should be designed to respond to the needs of individuals with unique requirements or problems. If the system is to be responsive to human needs, it is necessary to hold a specified person ultimately accountable. Fairness

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interact only in order to demand attention, not to communicate, not to interact gracefully." NORMAN, TURN SIGNALS, *supra* note 6, at 117.

109. 479 F.2d 153 (6th Cir. 1973).

110. *Id.* at 168.

111. Because of a subliminal faith in the superiority of mechanized intelligence over human intelligence, people have a tendency to believe that machines are less capable of error. They are more reliable, we believe, because machines are not subject to human whims, desires, or frailties. Once machines are appropriately programmed we expect them to function consistently and dependably. The dangers of placing unwarranted reliance on mechanical mentality arise in numerous legal contexts, and misadventures resulting from erroneous information generated by malfunctioning machines are often far more serious than those caused by misinformed people. Consider, for example, Campagna v. Hill, 385 N.Y.S.2d 894 (App. Div. 1976), which involved a father responsible for monthly payments of child support. A computer showed that he was $200 in arrears, and although he offered evidence to prove payment, the lower court judge, apparently convinced of the infallibility of the court's computer, refused to grant the father a hearing. The Appellate Division reversed. *Id.* at 895. This case illustrates that even courts fall victim to the impression that machines do not err.

requires that people who have no alternative but to deal with automated systems should have access to persons empowered to assist them in the event of misadventure.

The most basic requirement is that machines be courteous. A computer-based process ought to accept satisfactory substitutes that provide the system with needed information, even when the data is not furnished in the specific form demanded.[112] A human-centered system will, at the very least, direct the user to some person with authority to override the system rather than flatly reject alternative but otherwise adequate information inputs. Omission of courtesy as a design component does not prevent automated processes from functioning efficiently, but courtesy is indispensable to a well-functioning society.[113]

When we examine interface design from a legal perspective, the pivotal conception is one of vulnerability to transactional liability where human participants or functions have been displaced by automated

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112. A Canadian case, Remfor Industries v. Bank of Montreal, 21 O.R.2d 225 (1978), demonstrates the need to design "adaptability" into automated systems. The president of Remfor Industries notified the account manager at his bank to stop payment on a postdated check. The president gave the bank the date of the check, the check number, and the name of the payee. Although the check was actually made out in the sum of $10,853, the president had told the account manager it was for $10,800, and a stop payment order for a $10,800 check was entered into the bank's central computer, which was designed to process stop payment orders on the basis of the amount of the check and the account number. Since the computer was programmed to notify the bank clerks of a stop payment only when the amount of the check presented for payment matched exactly the amount entered into the computer, the bank's employees did not receive notification from the computer that payment had been stopped, and certified it without making further inquiry. The court held that the bank was not authorized to certify the check in the circumstances and was therefore liable to Remfor. The court took the position that the bank had been given the check number, the account number, and the payee of the post-dated check; the bank's procedure in limiting the information supplied to its computer to an amount and account number did not adequately safeguard the customer's interests. The computer, the court concluded, should have been programmed to notify its clerks of a stop payment order even where a slight variation in the dollar amount on the check existed. Rather than allow the consumer to be victimized, the court held the bank liable for the inflexibility of its computer system.

113. In 1973, The Canada Council sponsored a workshop that investigated the design characteristics of humane interactions with computer-based systems. The challenge of designing information systems that manifest attributes of civility in their intercommunication with users was set out in the report of that conference as follows: "Conditions need to be clarified under which humanization, as a discernible dimension, is included systematically as a design attribute [of] computer-based systems." Theodor D. Sterling, *Guidelines for Humanizing Computerized Information Systems: A Report from Stanley House*, 17 COMM. ACM 609, 610.

expedients.[114] Certainly, consumers should not be made to suffer when businesses seek to increase productivity and efficiency by automating their affairs.[115] From the point of view of interface design, however, the requirement of civility poses the vexing problem of constructing machines that emulate some of the most characteristic traits of humans.

Humans and machines are discontinuous conceptions. Computers are conglomerations of electronic machinery programmed to perform particular tasks in a perfunctory way. Humans, on the other hand, are thinking, feeling, spontaneous creatures who respond to their environment in what we consider a uniquely human manner. The crucial difference between the human and a mechanical substitute is the human's ability to relate creatively and emotionally to the environment. The most technologically advanced computers are still mere contrivances programmed to respond to their surroundings in stereotypically sterile ways. Present-day serial architecture ("von Neumann") computers are incompetent at simulating common sense behavior, notwithstanding the swiftness with which they perform logical and mathematical computations. Attempts to fashion universal robots or program computer-based systems to perform everyday tasks have met with meager success because insignificant increments in the complexity of a common sense task require an enormous escalation in processing power. Even humdrum assignments that demand a negligible quantum of good sense have overburdened contemporary computer-based systems.

Human civility is learned rather than pre-programmed. Humans begin their development with a lengthy state of immaturity. The tomfoolery of juveniles is a process through which they develop cognitive skills that enable them to perceive and interpret their visual and auditory environment at an early stage of their development. This, in turn, enables them to learn by experimentation how they should interact with their surroundings. The process of acculturation produces individuals with remarkable resiliency and adaptability of behavior.

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114. Circumstances in which tasks or transactions have come to be performed either by an unattended system or a human have given rise to some decisions in which the mechanical device creates a greater risk of liability than would the displaced human actor, as well as others in which the respective liability risks are reversed. Among the decisions already mentioned, Ellish v. Airport Parking Co, 345 N.Y.S.2d 650 (App. Div. 1973), and Marsh v. American Locker Co.,72 A.2d 343 (N.J. Super. Ct. 1950), illustrate reductions in liability risk from the standpoint of judgment and recountability, respectively. Lachs v. Fidelity & Casualty Co. of N.Y., 118 N.E.2d 555 (N.Y. 1954) is representative of the prevailing judicial attitude which views with disfavor attempts to reduce a transaction's liability exposure by displacing a human actor with a mechanical device. *See infra* note 118.

115. *See, e.g., Ellish*, 345 N.Y.S.2d 650 at 655 (Shapiro, J., dissenting).

To fashion an unattended system or robot capable of operating in a universal or generic setting instead of being limited to a particular environment for which appropriate behavior has been pre-programmed will probably require the simulation in machines of the process by which humans learn. Anticipated breakthroughs in parallel distributed processing, a technology in which considerable numbers of coupled microprocessors operate concurrently in the manner of a neural network, may ultimately lead to a point at which it becomes possible to construct proficient machines capable not only of processing stimuli, but also of comporting themselves with common sense. If machines could be designed that were capable of being rewarded or chastised, and thus susceptible to discipline, it would be possible to train them to discern appropriate behavior and comport themselves with civility in generic settings. Indeed, we would be able to construct mechanical analogues of emotions for such computerized systems.[116]

Another aspect of civility will require automated systems to be able to recognize that they are dealing with different classes of individuals. Furthermore, courts will ultimately require that computerized systems interacting with people possess a capacity not only to recognize and respond to classes of individuals and problems, but also to treat people as individuals. Human-centered systems must be able to recognize the fact that people differ in many personal characteristics and needs, and that conditions may necessitate according different people varied treatment. Although the court in *Palmer v. Columbia Gas, Inc.*[117] rehumanized the issue by requiring human intermediaries to be interposed between the computer-based system and consumers, the court might have achieved the desired result by directing a redesign of the system itself.

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116. See generally E.W. KENT, THE BRAINS OF MEN AND MACHINES (1981), which suggests that

> When building machines to deal with real-world problems in the general environment, we are going to build them to behave rather like we do, and we will probably find that the most expeditious way to build them is to incorporate some of the basic design features of our own brains. Under the circumstances it is inevitable that we are going to accept them ultimately into the family of sentient beings. That does not disturb me. Other people may react differently. Not because they really mind the idea of conscious machines per se, but because they fear a different kind of consciousness. It is not hard, for example, to find fears of emotionless, coldly logical devices dealing with humans in an inhuman fashion. I would like to point out . . . in this regard . . . that advanced devices like ourselves have emotional systems for very good reasons. We need them in order to be very powerful systems, and so will our robots.

Id. at 271-72.

117. 479 F.2d 153 (6th Cir. 1973). *See supra* text accompanying notes 109-10.

We are clearly seeking to embody very human characteristics in machinery. If such qualities as courtesy or consideration are to be incorporated in lifeless artifacts, these attributes must be translated into collateral counterparts appropriate to the perfunctory activities of an automaton. Deconstruction of the concept of civility in a mechanical context has revealed such rudiments as the following: minimizing the potential for indirection by postulating that automated processes must be made intelligible to users; requiring that some person be accessible and answerable as a "back up"; and insisting that automated systems have sufficient flexibility to cope with adequate though varied data.

B. The Failure of Automation Lacking Human Attributes

The Article now focuses on two examples of how the absence of the attributes described above can lead to the inadequacy of automated replacements for humans: forming contracts and replacing a human actor whose primary function is to provide security.

1. Automated Contract Formation

Vending machines are engaged in the business of selling unexceptional products such as stamps or candy. Through a clear plastic shield the browsing customer views different items, each with a posted price. Lawyers would say these machines are making offers. While there is no sign posted to that effect, it is plain to anyone who has inserted coins and snapped up a newspaper from a mechanical kiosk that vending machines, like the salespeople they replace, make offers. The machine is saying: "If you will deposit the posted price in me, I will relinquish control over the item you wish to purchase." As is the case with any contract, certain terms are implied by law to relieve parties of the necessity of reducing every contingency to writing and, more importantly, to conform unrecited terms of a transaction to the common understanding of virtually all members of commercial society. If a mechanical news dealer accepts the proffered coins and the purchaser finds herself holding fifty blank pages of newsprint disguised under a properly printed front page, the purchase price must certainly be returned. If the candy bar that tumbles from a vending machine turns out to be nothing but an empty wrapper, an action for rescission will undoubtedly lie.

The reasonable expectations of people interacting with machines are critical to making legal determinations regarding the validity of unattended transactions. The reasonableness standard is particularly appropriate when exceptional or complex transactions occur between

people and machines. The life insurance policy vending machine found in our major airports, for example, offers to shoulder the burden of unknown and unknowable risks. Anyone who has spent an afternoon attempting to understand the simplest insurance policy will readily appreciate the complexity of this arrangement. In situations where the purchaser of an insurance policy deals with a human salesperson, there is at least the possibility that the rights and obligations of the parties have been explained, so that some understanding or "meeting of the minds" may have been achieved. Likewise, when a customer signs and delivers an application for coverage to a human agent, it is reasonable to presume that the purchaser has read and understood the terms of the agreement. When, by contrast, a machine proffers the policy without affording the purchaser an opportunity for explanation, its limitations are not disclosed until the policy has come into full force and effect, after being ejected from the machine. Consequently, purchasers of a machine-vended policy are not bound by terms at variance with the common understanding. Companies which sell insurance by machine often find their contracts rewritten by courts on highly unfavorable terms.[118]

Judges have often considered that the potential for overreaching latent in transactions between people and unattended facilities is a sufficient justification to rewrite the terms of automated transactions. Consider the predicament of a New Jersey motorist who left a toll road at an exit where no human toll collector was on duty. The sign at the exit ramp demanding that a ten cent toll be placed in a box advised those without change to mail payment in an envelope provided for that purpose. A motorist who drove through the roadblock without depositing the money or taking the proffered envelope, only to find himself charged with refusal to pay the toll, responded "that he would have been quite willing to pay if the parkway had provided someone to make

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118. In Lachs v. Fidelity & Casualty Co. of N.Y., 118 N.E.2d 555 (N.Y. 1954), decedent-insured had purchased an airline insurance policy from a vending machine situated near the ticket counter of a "non-scheduled" airline. A sign with the words "airline trip insurance" was posted on the machine in letters ten times larger than other large-print words which were in turn many times larger than words that indicated the policy's coverage was restricted to flights on "scheduled airlines." *Id.* at 556-57. The insurance company was held liable on its policy even though the claim arose from the crash of a "non-scheduled airline" specifically excluded from coverage. The court noted that while it is appropriate, useful, and perhaps even necessary to sell insurance policies from automatic vending machines, "there must be additional care taken" where the sales agent is a machine which the customer may not question. *Id.* at 559. The teaching of this class of decisions is that the reasonable expectations of people served by automated facilities substituting for human agency are determinative of the legal rights and duties arising from such transactions.

change."[119] The court held that a motorist should not, in these circumstances, be considered to have refused to pay the toll.[120]

Automating contract formation will often engender insidious results because consumers are unaware of the precise terms of their bargain until it is too late to withdraw or make alternative arrangements. Consider, for example, *Thornton v. Shoe Lane Parking Ltd.*,[121] which involved a motorist who sustained personal injuries in a parking garage. The automatic machine at the lot entrance had ejected a receipt which would have advised the driver, had he bothered to look, that his parking license was subject to restrictions posted on signs within the premises. One such limitation purported to exculpate the lot's proprietor from liability for personal injuries. The court reasoned that the notice on the ticket machine inviting the motorist to park constituted an "offer" which the driver "accepted" by depositing money in the machine. The contract which thus came into force contained only the terms which the plaintiff could reasonably be expected to have known at the time he deposited the money. Accordingly, the notice on the receipt purporting to augment the parking arrangement with the conditions displayed within the premises was an invalid attempt to alter the terms of a contract which had been consummated prior to the delivery of the receipt.[122]

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119. State v. Richards, 254 A.2d 137, 140 (N.J. Super. 1969). Similarly, in People v. Myers, 223 N.Y.S.2d 787 (Erie County 1962), the evidence was insufficient to sustain a conviction for having deposited ten cents instead of the required fifteen in an automatic toll collecting device when the motorist protested that the light had turned green before he proceeded through the barrier. It did not seem proper, the court said, "that an agency can create a situation where some combination of coins less than the required amount will trip the toll device to signal a green light and then hold the driver responsible for making an improper deposit. *Id.* at 788.

120. *Richards*, 254 A.2d at 140.

121. [1971] 2 Q.B. 163.

122. Likewise, limitations printed on flight insurance policies vended by machine which disclaim liability for travel on "non-scheduled airlines" have similarly been held to form no part of the insurance contract, because the restriction differs from the understanding a customer might have had in the circumstances. *See supra* note 118.

2. Security

Machines that fail to emulate human attributes can give rise to significant security problems. For instance, numerous cases have arisen in connection with the self-service elevators and bell and buzzer systems that have come to replace doormen and elevator operators. Human elevator operators, in addition to bringing an elevator to a stop on the appropriate floor, provide passengers with some degree of protection from criminal activity, a humane factor lost when human operators came to be displaced by automated systems. Numerous cases have raised the question of whether elements essential to an elevator's proper function were sacrificed when human operators were replaced with buttons and self-closing doors, or alternatively, whether the discarded human amenities were merely incidental and not compelling.[123]

Some courts have held that a landlord could avoid reductions in rent for automating elevators by furnishing twenty-four hour lobby attendants instead.[124] To the extent that the security role of human attendants displaced by automated facilities is considered legally significant, the necessity of providing twenty-four hour attendants or other comparable alternatives must be decided on a case by case basis. Displacement of

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123. Rent control laws generally prohibit landlords from diminishing services their tenants are entitled to receive and impose rent reductions if a diminution in service is found to have occurred. In considering whether replacement of elevator attendants with automated systems constitutes a diminution of services, courts have used a two-step functional analysis. First, the way in which the automated performance differs from a superseded human performance is ascertained, in order to isolate the displaced factors. Then, the legal significance of those displaced elements must be determined..

Conversion from manual to automatic elevator service may result in a loss of ambience and security. The loss of ambience has not ordinarily been considered legally significant and consequently, does not constitute the diminution of services proscribed by rent control legislation. However, some courts have considered displacement of human elevator operators by automated facilities to result in a degradation of security precautions, making the absence of human beings legally significant. *See, e.g.*, Korein v. Conciliation & Appeals Bd., 444 N.Y.S.2d 93 (1981), *aff'd.*, 443 N.E.2d 473 (1982), (finding termination of 24-hour manned elevator to be an unlawful diminution of services).

124. *See* Smith v. Popolizio, 438 N.Y.S.2d 62 (Sup. Ct. 1981) *aff'd*, 454 N.Y.S.2d 435 (App. Div. 1982); *In re* Payson, 164 N.Y.S.2d 479 (Sup. Ct. 1957), *aff'd*, 170 N.Y.S.2d 988 (App. Div. 1958); Katz 737 Corporation v. Weaver, 165 N.Y.S.2d 867 (Sup. Ct. 1957), *modified*, 170 N.Y.S.2d 983 (App. Div. 1958), *aff'd*, 152 N.E.2d 523 (1958); *In re* First Terrace Gardens, 136 N.Y.S.2d 475 (Sup. Ct. 1954), *aff'd*, 140 N.Y.S.2d 447 (App. Div. 1955), *aff'd*, 132 N.E.2d 887 (N.Y. 1956); United Sec. Corp. v. McGoldrick, 119 N.Y.S.2d 917 (Sup. Ct. 1953); Jerlan Holding Corp. v. McGoldrick, 120 N.Y.S.2d 761 (Sup. Ct. 1953).

human doormen by telephonic or bell and buzzer devices has engendered a comparable body of case law.[125]

The automatic elevator and bell and buzzer cases arose in the context of rent control legislation and would be of academic interest only but for *Kline v. 1500 Massachusetts Avenue Apartment Corp.*,[126] which swept away the antediluvian notion that landowners do not have crime-prevention duties. *Kline* recognized a landlord's duty to take reasonable precautions to protect third parties from crime and represents what is now the virtually unanimous American view. The *Kline* court did not imagine that prevention of crime in the context of premises liability would always remain a predominantly human affair and suggested that a proprietor's obligation to reestablish the preexisting level of guard and doorman service could be met by installing tenant-controlled automatic lock and intercommunication systems.[127]

The quality of security afforded by automated systems, however, may not prove sufficient to discharge a duty to make property secure from a third party's criminal acts. In *Green Companies v. DiVicenzo*,[128] for example, $562,000 was awarded to a real estate broker who was severely beaten in an office building despite a security strategy that employed a closed-circuit camera surveillance system to monitor entry into the building. That court considered replacement of human attendants by the closed-circuit television system a diminution of security,[129] since the physical presence of a human attendant subsumes a capacity for deterrence that is not reproduced in a camera surveillance system. Thus, while replacing human attendants by automated alternatives was suggested by the *Kline* court, that technique was characterized in *DiVicenzo* as "a relaxing of security conditions when the owner changed to a less effective security system."[130]

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125. The doorman's main function is to monitor the ingress and egress of tenants and their guests, a function automated by intercommunicating bell and buzzer devices. Such conversions displace the ambience and security created by a human presence. While some courts have held the mechanical devices sufficient to compensate for the loss of the full-time security provided by a doorman, others have required that a lobby attendant also be present 24 hours a day. *See In re* Willey, 141 N.Y.S.2d 643 (Sup. Ct. 1955), *aff'd sub nom.* Gomez Realty Corp. v. Abrams, 147 N.Y.S.2d 676 (App. Div. 1955); Rogol v. HRB Realty Corp., 94 N.Y.S.2d 847 (Sup. Ct. 1949).

126. 439 F.2d 477 (D.C. Cir. 1970).

127. *Id.* at 486-88.

128. 432 So.2d 86 (Fla. Dist. Ct. App. 1983) (per curiam).

129. When the plaintiff originally rented an office in the building, a security guard was stationed at the main entrance from 4:00 p.m. until 11:00 p.m. The guard was later supplanted by an electronic lock and buzzer system and a closed circuit television system which was monitored from another building. *Id.* at 87.

130. *Id.* at 87.

Refinements in technology have not only provoked adjudication on the question of whether liability should be imposed for losses caused by a less than satisfactory interface, but have occasionally involved judges in supervising the minutiae of interface design. One such case, *New York v. Citibank*,[131] arose out of what New York's Attorney General viewed as a deficient interface for an ATM. Design deficiencies in Citibank's automated facilities, he alleged, promoted fraudulent withdrawals from its customers' accounts.[132]

The crux of the Attorney General's position was that the use of computerized machinery to eliminate the costs associated with employing human tellers had generated unnecessary hazards because the bank had failed to seek out the best available ATM technology and upgrade its machines in light of technological advances. Posted warnings that cautioned customers about rampant chicanery in the use of Citibank's cash machines were alleged to be inadequate. "There are," the Attorney General asserted, "readily available alternatives which more effectively protect the public."[133] Warnings ought to have been flashed on the cash machine screen at the commencement of each transaction instead of merely being posted on a wall.[134]

It was further alleged that Citibank had failed to make use of the best available technology in that its ATMs were technologically inferior to machines that ingested and retained the customer's access card during the entire transaction, a design feature claimed to account for the fact that the users of ATMs at other banks were not being victimized by the scam perpetrated on Citibank's customers.[135] A newly available

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131. 537 F. Supp. 1192 (S.D.N.Y. 1982).

132. The scheme by which Citibank's customers were defrauded is described in Feldman v. Citibank, 443 N.Y.S.2d 43 (Civ. Ct. 1981). Con artists employed a number of variations of the following ruse to victimize the bank's customers. A larcenist would wait at an automatic teller machine holding the telephone handset provided by the bank to report difficulties until a customer arrived and activated an adjacent machine. The con man would suggest the customer use another machine because the one that had been activated was out of order. From his strategic position at the telephone between the machines the thief would watch as the victim entered their personal identification number and later enter that number on the activated machine which the victim ignored because he believed it to be inoperative. The thief would inveigle the customer to reinsert the card by dissembling that this was suggested by the bank's customer representative over the phone as a means to determine why the machine was not working properly. The scoundrel was, at this point, able to empty the customer's account. *Id.* at 45.

133. *See* Attorney General's Petition at ¶ 28, New York v. Citibank, 537 F. Supp. 1192 (S.D.N.Y. 1982) (No. 81-7273).

134. *See* Affidavit of Assistant Attorney General Stephen Mindell at ¶ 18, New York v. Citibank, 537 F. Supp. 1192 (S.D.N.Y. 1982) (No. 81-7273).

135. *Id.* at ¶ 14.

machine used a specially designed computer screen adjustable to the user's line of vision, thus preventing rubbernecks from espying personal identification numbers.[136]

The petition also contended that it was "technologically possible" for Citibank to rework its computer software to prevent a second withdrawal from being made within a short time after an initial withdrawal from a customer's account.[137] The architectural design of alcoves into which cash machines were fitted was alleged to be imprudent because positioning a service telephone alongside each machine provided interlopers with an excuse to position themselves at a location from which they could see customers entering their personal identification numbers.[138]

This litigation resulted in entry of an order stating that the settlement agreement it confirmed did not constitute an adjudication on the merits and could not be cited as such. By the terms of the settlement agreement, Citibank was required to file with the court under seal a description of the user interface changes it would implement to prevent a recurrence of the fraud. Because no opinion was reported (save on a peripheral jurisdictional question), a pivotal litigation for defrauded consumers has received little notice.[139]

136. *Id.* at ¶ 16.

137. *Id.* at ¶ 17.

138. *Id.* at ¶ 18.

139. On December 9, 1982, the Attorney General of the State of New York issued a press release regarding the settlement in which he announced that Citibank had agreed to pay approximately $135,000 in restitution and interest to 485 of the bank's customers, and that an additional 1500 people victimized by the scheme would be eligible to receive approximately $360,000 in refunds.

C. Machines and Bureaucracies

When we compare human bureaucracies to computerized systems, we find that the latter are the mechanical analogue of the former. Indeed, computerized systems are the objectification of the concept of bureaucracy.[140] When we focus for a moment on the workings of a typical bureaucracy, we find that its components are people with specifically designated and limited functions. It is a human system in which people are compelled to act in a stereotypical manner much like machines.

Consider for a moment a hypothetical university that requires students to pay tuition in accordance with rules set out in its catalogue. If a student is five days late in paying tuition, the university might add an additional charge of ten dollars. For students a week or two weeks late, the late fee might be twenty dollars. When a student approaches the bursar's window to pay tuition, the clerk behind the window computes the appropriate penalty "automatically," without bargaining over the appropriate amount of the penalty, discussing the matter with the student, or assessing the validity of a proffered excuse or explanation. The clerk functions in this manner not because she was "designed" to do so, but because she has been instructed to follow a set of rules. Her role entails following rules that generally leave no room for deviation.

Clerks, secretaries, and receptionists are "components" of the large human "machines" we call bureaucracies. Even in the most bureaucratic of systems, there is usually someone who can override the programmed application of particular rules. If our hypothetical student, instead of being five days late, missed the tuition deadline by five minutes, we hope it would be possible to locate someone with power to excuse this insignificant lateness. People with the power to relax the rules or alter requirements in appropriate cases introduce a modicum of sensitivity into perfunctory operations.

Bureaucracies become dehumanizing, however, precisely when there is no one with the power or will to change the rules. In our

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140. This apprehension, that bureaucracies and machines are correlative conceptions, was first formulated by Norbert Wiener as follows: "I have spoken of machines, but not only of machines having brains of brass and thews of iron. When human atoms are knit into an organization in which they are used, not in their full right as responsible human beings, but as cogs and levers and rods, it matters little that their raw material is flesh and blood. What is used as an element in a machine, is an element in a machine. Whether we entrust our decisions to machines of metal, or to those machines of flesh and blood which are bureaus and vast laboratories and armies and corporations, we shall never receive the right answers to our questions unless we ask the right questions." NORBERT WIENER, THE HUMAN USE OF HUMAN BEINGS, 212-13 (1950).

common experience, we often must pierce at least two or three layers of bureaucrats of ever-increasing authority before we can hope to reach someone with the authority to exercise discretion in the sense of being able to deal with individuals according to their particular circumstances rather than by application of inflexible rules. We are frustrated when the available personnel have only an illusory authority to vary the impact of rules. Such persons typically respond to pleas for special treatment with something to the effect that "a rule is a rule." Such situations may be worse than those in which there is no human to deal with. Bureaucracies function adequately only if the system contains persons with actual rather than notional authority to permit a departure from the rules.

A related consideration is how frequently deviations should ordinarily occur. The primary justification for bureaucratic structures is economic. It is ordinarily uneconomical to use the highly paid individuals who might be entrusted to properly exercise judgment and discretion in individual cases to deal with the public on all levels of an organization. Hiring clerks at minimal wages to respond to situations "according to the rules" is obviously less expensive than employing highly skilled managers with the knowledge and authority to handle each person and problem on an individual basis. Furthermore, utilizing highly paid individuals with an ability to exercise discretion to deal with the public in the first instance would not be the best use of their time. But would we say the same of machines? If, as has been suggested, human bureaucracies are analogous to machines in that human components are "programmed" to respond according to fixed rules, computerized systems are the objectification of a bureaucracy. Machines act in a stereotyped manner because the essence of what machines are requires that they do things according to the predetermined rules of a fixed design or program. Computerized systems have the potential to soften the harshness of bureaucratic behavior without sacrificing the economic benefits of the bureaucratic structure.

A computer can deal with a much greater number of situations than the rules designed for the clerks of a human bureaucracy would permit. A machine might be programmed with complex rules designed to resolve the individual problems of particular types of people in need of personalized treatment. A computer operating in a stereotypical manner might actually interact with the public as a decision maker in a more humane fashion than a large crew of human clerks working for minimum wages, because it would take into account more of the particular

circumstances of particular people.[141] Such a computer-based system would undoubtedly operate more economically than a system composed of human clerks. Most of the problems faced by such computerized systems would not draw upon the full complexity of its rules base. The system would, however, be able to provide an individualized response in the occasional case which required the full power of its program. And it is unlikely that anyone would say that dealing with the public in the first instance with a high level of discretion would not be the best use of the computer's time.

Mechanization of decision making may help eliminate some of the worst aspects of bureaucratic interaction. Whether interaction with the public in a stereotypical way occurs in human bureaucracy or relies instead on sophisticated computer-based systems, there will always be problems beyond the competence of either, problems that require an exercise of human discretion. We, therefore, must require that these systems afford access to human beings of sufficient authority to vary their requirements in appropriate cases. We are thus returned to the sentiment of the court in *Palmer v. Columbia Gas, Inc.*[142] that a human must always be in charge.[143]

V. CONCLUSION

The late Supreme Court Justice William O. Douglas wrote: "The search . . . today is for ways and means to make the machine . . . the servant of man."[144] We owe it to the memory of Justice Douglas, no less than to ourselves, to meet his challenge.

This Article has attempted to show that the law can be of tremendous help in this endeavor. Courts have been asked repeatedly to pass on questions of human-centered design, and are well-qualified to do so; human factors engineers should study the written opinions of judges, which can yield much insight into the nature of the problem and its

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141. Theodor Sterling points out, "[w]e have blurred a distinction between manual and automated systems because our guidelines apply whether or not computers are used. We think that with automation may come the unique opportunity to include the humanizing features that are so sadly lacking in the current manual procedures that control economic and social affairs." Sterling, *supra* note 113, at 610

142. 479 F.2d 153 (6th Cir. 1973). *See supra* text accompanying notes 109-10.

143. It is worth noting that computerized systems are as prone to miscalculation and blunder as any human process. Consequently, the law must apportion responsibility for mishaps among the owner of the computer, its programmer, and other possible defendants. Furthermore, the development of intelligent artifacts will bear upon the degree of care we exact from persons who permit computerized systems to make deleterious decisions.

144. WILLIAM O. DOUGLAS, POINTS OF REBELLION 96 (1970).

possible solutions. Likewise, lawyers and judges should keep the work of the engineers in view in arguing and implementing the law, especially where, if left to its own devices, the market would be unlikely to advance the cause of human-centered design. The result of such a synergy will of necessity be an increase in the safety and usefulness of technological devices, a proper allocation of liability between designers and users of these devices, and (one would hope) an abatement of the fear and hostility towards technology which is evident in our society. It may even be the case that a fuller understanding of human design principles will temper the machine-like intransigence of our human bureaucracies.

As we come to interact with and rely upon machinery to an ever-greater degree, we need to take positive steps to make our machinery more like us. In this way, we will avoid losing our humanity in the process.