of this machinery and make tables of its operating characteristics with different inputs and in different milieus. For these problems, statistical descriptions, especially one-dimensional descriptions like heritability, can only be poor and, worse, misleading substitutes for pictures of the machinery. There is a vast loss of information in going from a complex machine to a few descriptive parameters. Therefore, there is immense indeterminacy in trying to infer the structure of the machine from those few descriptive variables, themselves subject to error. It is rather like trying to infer the structure of a clock by listening to it tick and watching the hands. At present, no statistical methodology exists that will enable us to predict the range of phenotypic possibilities that are inherent in any genotype, nor can any technique of statistical estimation provide a convincing argument for a genetic mechanism more complicated than one or two Mendelian loci with low and constant penetrance. Certainly the simple estimate of heritability, either in the broad or narrow sense, but most especially in the broad sense, is nearly equivalent to no information at all for any serious problem of human genetics.

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Humanizing Computerized Information Systems

Guidelines developed in a series of workshops are presented and their implications are discussed.

Theodore D. Sterling

The accumulation and control of information is a critical function for government and private, industrial and nonindustrial organizations. Yet the role of information as an organizational resource is not very well understood, especially as it is related to the organization's environment. What does appear is that computerized information systems have become a facilitating technology that interacts with organizational, historical, and environmental pressures and goals to shape not only the internal structure of an organization but also its interactions with society (*1, 2*). There is little doubt that the computerized or automated information system is revolutionizing the management of most, if not all, systems by which goods and services are produced or information is accumulated. This should be a source of great concern.

Weizenbaum (*3*) asked whether large computerized systems can be used by anybody except governments and really large corporations and whether such organizations will not use them mainly for antihuman purposes. The power of computerized information systems to control large enterprises answers the need to manage large systems and make them amenable to human control. By any criteria of management performance, computerization of a system permits its detailed control, and thus the computer is the ideal management tool. But the cost of the control is high. Start-up costs to redesign and computerize large-scale enterprises are immense. In concentrating on feasibility and workability and simultaneously minimizing costs, few systems designers seem to have been concerned about whether their products will be used for antihuman purposes.

In many ways, it is immaterial whether control over the management network is exercised by manual means or by automation. As long as official procedures are detrimental to human dignity, nothing is changed in converting to automation—except that individuals may shift the blame for their oppression from the human cog to the computer cog. It may be necessary, therefore, to clarify the dehumanizing components of a management system, which may be present whether or not the system has been automated, and to provide relief for any suffering they may have caused.

In a previous analysis (*4*) I pointed to two design strategies that account in large part for the presence of dehumanizing features in a management system. First, the efficiency of an enterprise is commonly increased by treating the recipients of the service and participants in the system as unpaid components whose time, effort, and intelligence do not appear in the cost accounting. Then, in order to maintain the efficiency of procedures once they have been established, the system is made exceedingly rigid, permitting freedom of action at only a few, usually hidden, focal points of real control. Dehumanizing features are thus already ingrained in most systems of management, and automation

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of such systems simply transfers the dehumanizing practice from one means of exercising control to another, codifies it in computer programs, and expands its influence to a larger circle of recipients and participants. To provide for the smooth and efficient operation of a largely computerized management system, the automation process makes demands of its own on all participants which decrease the area of free action remaining to the individual. Rules of procedure are thus dictated by the growth of machines and not by the needs of man. As a consequence, it is possible for the machine to capture the prerogative to formulate questions important to man. If we take such developments as inevitable we are surrendering our humanity.

The point is that an intelligent understanding of a machine mode of control may be delayed until long after this control has been exercised. Wiener (*5*) argued that although procedures laid down to satisfy a process of automation are subject to human criticism and modification, such criticism may be ineffective because it may not surface until long after it is relevant. It may be too late then to correct the damage to the human condition. Systems are not detached from the people they interact with and the settings they create, and people strive for a sense of dignity, have needs that should be taken seriously, like to be treated with consideration and courtesy, and occasionally act as individuals—in short, they are entitled to be treated as human beings.

Despite the overriding importance of a person's dignity and humanity, little is known in terms of "scientific" specifics about the operational meaning of these concepts or the antecedent conditions that enhance or diminish them. Relatively few analyses have been devoted to systems features that may humanize organizations (*6, 7*). We know of only one attempt to incorporate humanizing features in a system and to evaluate their effects (*8*). Yet we cannot afford to wait for knowledge to accumulate about the procedures to be incorporated in information systems or information parts of systems to help avoid dehumanizing or add humanizing qualities to them. We live in a time of active proliferation of new and revised management procedures, and designers of information systems are organizational designers as well, who cannot avoid changing organizations (*7, 9*). This is especially true of the proliferation of management information systems, which are more than information systems in the technical sense, as they include all bureaucratic procedures and perhaps all systems components that enter into the production and distribution of goods and services and so dominate the economic, political, and social management of society. Organizational design should be taken on as an explicit activity and management information systems implemented in such a way that they create a more humane setting.

Gouldner (*10*) showed how rules and regulations respond to the self-interest of those who govern and are governed. But to influence the shaping of new bureaucracies and other management systems, it is first necessary to isolate the crucial categories of design features that may make manifest humanizing or dehumanizing qualities of information systems. The analysis presented here is based on the guidelines developed by the Stanley House workshop on humanizing computerized information systems (*11, 12*) in a serious attempt to isolate such design features. The guidelines are grouped into five broad categories, as shown in Table 1.

Many of the Stanley House criteria make sense as procedures for softening a bureaucracy as well as making an information system less rigid. There is no real distinction between manual and automated systems, and guidelines apply whether or not computers are used.

Discussion of Guidelines

By and large, the Stanley House guidelines are self-descriptive. This discussion is designed to illuminate their less obvious aspects and point to special problems that arise in connection with their implementation.

Criterion A2 is not a commonly encountered consideration in systems design. And, indeed, courtesy is not a substitute for real rewards, high quality of service, or other qualities. However, it is possible that courtesy is a prerequisite of humane society. In a rehabilitation hospital where courteous communications were part of a specially designed hospital information system, employees were pleased with that feature and regarded it highly (*8*). It is difficult to evaluate the importance of this courtesy criterion precisely because experience with courtesy in automated systems has been so rare.

Criterion A5 has far-reaching implications for a system's cost and efficiency. One of the favorite methods for optimizing the efficiency and minimizing the cost of a bureaucratic system is to require the individuals being served to supply the necessary information at each procedural com-

Table 1. Stanley House criteria for humanizing information systems.

A. Procedures for dealing with users

1. The language of a system should be easy to understand.
2. Transactions with a system should be courteous.
3. A system should be quick to react.
4. A system should respond quickly to users (if it is unable to resolve its intended procedure).
5. A system should relieve the users of unnecessary chores.
6. A system should provide for human information interface.
7. A system should include provisions for corrections.
8. Management should be held responsible for mismanagement.

B. Procedures for dealing with exceptions

1. A system should recognize as much as possible that it deals with different classes of individuals.
2. A system should recognize that special conditions might occur that could require special actions by it.
3. A system must allow for alternatives in input and processing.
4. A system should give individuals choices on how to deal with it.
5. A procedure must exist to override the system.

C. Action of the system with respect to information

1. There should be provisions to permit individuals to inspect information about themselves.
2. There should be provisions to correct errors.
3. There should be provisions for evaluating information stored in the system.
4. There should be provisions for individuals to add information that they consider important.
5. It should be made known in general what information is stored in systems and what use will be made of that information.

D. The problem of privacy

1. In the design of a system all procedures should be evaluated with respect to both privacy and humanization requirements.
2. The decision to merge information from different files and systems should never occur automatically. Whenever information from one file is made available to another file, it should be examined first for its implications for privacy and humanization.

E. Guidelines for system design having a bearing on ethics

1. A system should not trick or deceive.
2. A system should assist participants and users and not manipulate them.
3. A system should not eliminate opportunities for employment without a careful examination of consequences to other available jobs.
4. System designers should not participate in the creation or maintenance of secret data banks.
5. A system should treat with consideration all individuals who come in contact with it.

ponent with which they are involved. Further, in order to ensure an uninterrupted flow of work, recipients of service are required to stand in queues at each point. Yet very often the required information can be made available to each procedural component at relatively small cost. It may be particularly important to do this at times when participating individuals are under additional pressures. One pernicious example is the queuing of hospital patients before special treatment or diagnostic centers (such as physical therapy or radiology). Appointments for individual patients made through the hospital information system could eliminate the queues of sick people in drafty corridors so typical of hospital operations. Similarly, a good system could eliminate unnecessary queues and travel by job seekers. On the other side of the coin, we find that the repetitive and unrelieved need to supply a service to queues of recipients is often dehumanizing to service personnel, and the constant demands of the queue prevent trained personnel from applying their skills in a selective manner (*8*).

Criteria A6 and A7 may be related. Large-scale systems tend to be converted onto computers as cheaply as possible. In order to do this a global method of design is often used in which all subprocedures are rigidly defined into a single large structure. The more flexible, albeit much more expensive, way is to build a basic system of linkages to which different procedural modules can be attached. Whenever modifications are required it is then only necessary to reprogram the one affected module. One of the side effects of the global method of design is that it is difficult to modify the system to deal with errors that had not been anticipated. Yet errors of every sort, especially those related to information input, are almost unavoidable in a system that handles a large number of transactions. There is a suspicion in the concerned data processing communities that many corporations leave some errors uncorrected because it is cheaper to lose an occasional customer than to correct for each mistake. The human interface would be a desirable component of a system, even when correction of error may not be the major need. Human contact may be needed for individuals in vulnerable positions, such as the unemployed or the sick, to answer questions about unavoidable delays in providing a service or replying to an application; or just to soften the impact of an impersonal bureaucracy.

The human interface is lacking in most systems we have examined so far, and it may well be that the interface will have to be provided from the outside. One extra-organizational scheme is to have a computer ombudsman serving a large community. Such an ombudsman service could be provided by a professional, consumer, or governmental body, or by a combination of organizations, and would be the mediating link between the perplexed citizen and the perplexing system (*13*).

Related to A6 and A7 is A8, the criterion that management ought to be held responsible for the situation where faulty design causes discomfort and frustration to individuals unable to get relief or attention from a system. Poorly designed systems are often not corrected because no one is really responsible for their actions. As a consequence, Kafkaesque nightmares may be created for users and participants.

In many ways, procedures for dealing with exceptions may be the most necessary components of a humanized system. The human condition is never so homogeneous that a set of rules can be devised to cover all exigencies. Once bureaucratic procedures are structured, they tend to become rigid even though they may contain provisions to deal with human needs. Exceptions are always difficult to manage. To provide for such flexibility, it is absolutely necessary to provide access to focal points of information or control in order to accommodate a departure from the "norm" where the users' needs require it.

I do not believe that there are technical obstacles to incorporating in working systems the kind of criteria that would permit the consideration of exceptions. My main concern is that obstacles will be generated by unavoidable conflict among humanizing criteria and between such criteria and the use of the system. Consider criterion B1, for example. Some employers of manual job bank programs rely on the face-to-face system to weed out those whom they regard as undesirable applicants. Here is an unstated trade-off between flexibility and equity. Also unstated may be the need to specify whom the system serves. What defines a class of individuals depends, in each case, on the kind of services the system provides or the demands it makes on participants. It is easy to say that a system should at least be aware that affected individuals differ in many personal characteristics and needs and should be accorded correspondingly different types of treatment. However, to achieve that may require an explicit definition of the purposes of a system. For instance, does a job bank serve the job seeker or the employer? It obviously serves the needs of both, and when a conflict exists between these needs it may not be feasible to make that conflict explicit.

In a similar sense conflicts may be created by criterion B4. There is a large variety of situations in which individuals may not wish to avail themselves of services or to provide a system with information touching on their private lives. The whole idea of "choice" is foreign to most large-scale systems, whether automated or manual. The provision of choices may very well mark the border between the dehumanizing and the humanizing system. However, it will add greatly to the complexity of systems, because permitting individual choices may set up conflicts with other criteria or services, including some through which the system seeks to become less dehumanizing. For example, in Canada, Provincial Health Services send an account of services rendered to the head of household. This would seem to fulfill the requirement of keeping the user or recipient of a service informed. Other members of the family, however, might object to finding their health needs reported to the head of household (without necessarily detracting from the affection they might feel for their spouse, parent, or provider). While this problem could be alleviated by addressing the report to the concerned individual, other situations may arise that cannot be easily resolved without providing a wide variety of choices. The spouse of the head of household or the adult children may not wish to inform the head that they have sought medical services. In fact, reporting such information may be harmful to a course of therapy or may needlessly disrupt family life, as when members of a family are seeking treatment for venereal disease or drug addiction, for example.

Opinions are divided about the extent to which information about individuals ought to be withheld from them and from others. Yet there is general agreement that provisions are needed for making access to and evaluation and correction of that information possible.

Criteria concerning actions of the system with respect to information have been widely discussed, so no additional comments may be necessary except in one case—criterion C4. This would make it possible for individuals to add to the system information which they think bears importantly on their background or needs, even if the information is not important for processing their files. This might not add anything to the efficiency of a system, but would add a great deal to the psychological comfort of affected individuals.

Requirements for safeguarding the privacy of individual records may seriously conflict with requirements for humanizing an automated system. In general, the more information a system has about individuals who are affected by it, the more likely it is that it can be humanized, but also the easier it becomes to misuse that information and to violate individual needs or desires for privacy and confidentiality. The extent to which individuals are entitled to privacy or even wish privacy is a matter of political

or social decision, as is the extent to which individuals ought not to be dehumanized by a system. Privacy versus humanization is an issue that has not received sufficent attention, and our experience with these concepts is too limited for it to be possible to compare requirements for privacy with those for humanization or make judgments on which is more important. However, it is clear that a very private system with no humane provisions may be just as undesirable as a very humane system with no safeguards to protect the privacy of its participants.

What makes procedural features desirable or undesirable with respect to privacy or humanization can be determined only in the context of the purpose of the system and the safeguards possible. Some systems that list individuals and information about them are desirable and others are not. They may also be desirable and undesirable to different people. For instance, a detailed file on handicapped children in the community would be useful for providing individual services, allocating community resources, and directing planning for schools and recreational facilities. On the other hand, attempts have been made to keep on file the names and records of minors who have been convicted of criminal offenses and to merge such files with other record systems. This has met with opposition from thoughtful members of the community, including members of the police department, and would be very objectionable, at least until adequate safeguards against abuse of such systems have been firmly defined and can be implemented. In the final analysis, it is not only a file's existence but its use which determines its ethical value. Nevertheless, the social and political considerations underlying criterion D1 can be resolved within the context of a particular system. What we are saying is that society can decide whether and how a file of handicapped children or of juvenile offenders should be assembled, maintained, and used.

It may be much more difficult to deal with criterion D2. Central to the problem of privacy is the very much enlarged information base available to government agencies when it becomes possible to merge information from different files. Merging of information may also make many systems more efficient and might make their action more equitable or even more humane. But it may be more to the point that under the guise of humanizing systems or making them more equitable (not necessarily the same thing), the rights of individuals for privacy and freedom from government surveillance in a democratic society may be seriously compromised. For example, the new Insurance Corporation of British Columbia, which is regulated and run by the provincial government, provides compulsory insurance under the name Autoplan for all drivers and car owners and bases its rate structure on records of driver violations. It is disquieting to note the ease with which Autoplan has been able to merge court and police files with records of largely business activities of Canadians in British Columbia without a public examination of this important step. Nor has there been public opposition to the extension of Autoplan to other insurance areas. In a similar vein, Lauden (*1*) has shown for four U.S. police and welfare systems how easily information from many sources may be merged. These are perfect examples of the type of activities warned against by Wiener (*5*), who predicted that the needs of large-scale government systems would generate practices which would be discovered only after they were well established.

It is thus clear that the extent to which a system can or will incorporate humanizing or dehumanizing features depends on economic, social, and political decisions. There are limits to the power of managers, engineers, systems designers, and scientists to provide for the inclusion of many desirable features in systems. So we suggest a set of ethical principles—criteria E1 to E5—which, if followed, will ensure that within any set of constraints a system will tend to be humane rather than dehumanizing.

Largely because many transactions of an automated system are difficult to inspect and by their very nature are less open to view than their manual predecessors, the requirement that systems should not deceive or trick, criterion E1, becomes of paramount importance. But even when a system is restrained from deception by law, it may still try to violate the spirit if not the letter of the law. (Common examples are billing practices whereby attempts are made to hide the amount of interest that is being collected from customers or that would be collected if the customer pays only part of what he owes.)

Computerized transactions make it possible for systems to assist participants without needlessly exploiting their labor (criterion E2). The idea that users must provide supportive services in order that a system may function is deeply ingrained not only in the designers of systems but also in the individuals they serve. Members of society are conditioned from birth to stand in line and fill out forms in order to register, to pay, or to receive. They have been habituated to supply information and contribute by their labor wherever they sought to receive a service, were ill, or provided a service for the government (such as paying taxes). It is grotesque but true that when the Nazis led millions of people into concentration camps and eventually into gas chambers, the victims had to stand in lines and deliver their possessions, provide information, and perform all the necessary services required to part them from their goods, their loved ones, and finally their lives. Manual systems burden recipients of a service with a great deal of effort to make the systems function smoothly. Computerized systems do not need to do so, or not really to the same extent. However, the temptation is always there to exploit the willing and conditioned cooperation of members of society. A contrary attitude, that the system should be burdened rather than the human component, needs to be fostered.

Similarly, an attitude should be cultivated by systems designers that all individuals, including employees, who come in contact with a system should be treated with the same consideration (criterion E5). It has been established that organizational structure produces characteristic patterns of alienation. For instance, Blauner (*14*) has shown that workers may develop perceptions of "meaninglessness," "powerlessness," and "work estrangement," depending on how they are fitted into an industry's technology (*15*).

We have chosen to group criterion E3 with ethical rather than economic and social or political considerations. Within the area of information systems and systems control through computers, there are many types of employment that are relatively pleasant and interesting and offer opportunities to large numbers of individuals which are difficult to find elsewhere. The overall cost of eliminating such jobs may be high. This is true when computerization of technology affects jobs that rely heavily on human skills and qualities of perception, attention, and intelligence. There are severe costs when sources of employment that provide interesting, challenging, and above all human types of employment are eliminated. One example of an endangered group, victims of the computerization of communication networks, is telephone operators. It is questionable that replacement jobs for this large number of eliminated positions which offer equally acceptable work for humans are available. The cost of finding employment for the communication workers who ordinarily would have worked for the telephone system has to be borne by society and not by the telephone company, and there is no way to assess or repay the costs to individuals who are forced into less satisfactory employment because opportunities for interesting and humane jobs are eliminated. From an economic point of view, this example shows that a cost-benefit analysis of job elimination through automation should not be based on the ef-

fects on a particular industry alone, but should include society as a whole. While it is recognized that it may be difficult for the systems designer to resist the temptation to eliminate such desirable jobs, he should be the first to recognize when they are in danger of being eliminated, and it behooves him as a human being to sound the alarm.

A Final Word About Economics

Perhaps the most serious obstacle to the inclusion of humanizing modules is that they reduce the efficiency of most information systems. Their inclusion will increase overhead in terms of design effort, complexity of procedures, and execution time. It may even be necessary to add to the physical resources of central computers (to provide a larger memory, a greater ratio of input to output, and so on). Consequently, appreciable research along these lines is not expected to be initiated by systems designers and managers, whose primary commitment is to efficiency. While our discussion is not designed to come to grips with the concern of those who are highly cost-conscious, we are nevertheless suspicious of those who refer to humanistic features as negative externalities and who hope that some market mechanism will handle their underlying problem. There is also a "humanistic" side to the debate (*12, 16*).

Lauden (*1*) makes a convincing case that the arrival of the third-generation computer offered new hope for administrative reformers, and indeed many administrative reformers attempted to fulfill this hope almost immediately. The new computer technology promised more closely integrated (which meant centralized) elements of federal, state, and local bureaucracies. It promised better decision-making, better government, better production, better distribution, and better allocation technology. Another important factor, Lauden stressed, is that the value to society of changes in (computerized) information systems does not have to be tested through the electoral process. Similarly, technological changes in industry rarely depend on decisions by stockholders. There are thus factors that shape computerized information systems and restructure means of producing and allocating goods and services or collecting information that are determined solely by political or industrial management and are neither controlled by nor responsive to social pressures. In the case of information systems, political ends are often achieved by management under the guise of instituting cost-saving efficiencies.

The utility of humanizing procedures will not be revealed in ordinary cost-benefit calculations but in the quality of life. Should we burden ourselves and future generations with dehumanizing practices designed and implemented today? Must not the wish to keep systems humane and dignified take its place with the desire to keep the air and the water palatable as a necessary countermotive to the drive of government and industry to be as efficient and cost-conscious as possible?

Summary

Computerized management information systems increasingly determine all bureaucratic and management procedures that control the production and distribution of goods and services and the collection of information. Thus, they begin to dominate the economic, political, and social management of society. With this domination come procedural features that may dehumanize participants or users affected by the working of most public and private organizations. Yet, despite the overriding importance of a person's dignity and humanity, little is known in terms of scientific specifics about the operational meaning of these concepts or of the antecedent conditions that enhance or diminish them. It will be too late if we wait for knowledge to accumulate about procedures to be incorporated in information systems or information parts of systems to avoid dehumanizing or to add humanizing qualities to them. A set of guidelines has been developed in a series of workshops sponsored by the Canadian Information Processing Society, Canada Council, and Simon Fraser University. These guidelines may apply where organizational design needs may be met and management information systems implemented in such a way that they create a more humane setting.

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