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USER-CENTERED SOFTWARE DESIGNS

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User-Centered Software Designs

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ABSTRACT

Many computer programs that are technically well designed fail to meet the human or organizational purposes they were expected to serve. Prevailing design methodologies stress either special technical devices or policies of involving people in the design of software they will use. Several user-oriented design strategies and their limitations are discussed. An expanded conceptual framework which includes both the personal characteristics of designers and features of the organizational settings in which they work is presented. The framework is used to develop a set of policies for practitioners to help foster the development of user-centered systems.

KEYWORDS:

User-centered design, socio-technical systems,
user-orientation, sociology of computing,
software design

CR Categories:

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The Problem

This paper focuses upon users, the forgotten people in software design. It develops a framework to analyze the conditions under which software design groups are most likely to produce systems that meet the needs of their users.

During the last decade, computers have been applied to an immense variety of managerial, engineering, industrial and scientific applications. Unfortunately, many computer programs that are well designed in terms of technical criteria, such as run-time efficiency, fail to meet the human or organizational needs they were expected to serve [38]. While the technical computer literature describes algorithms and systems that are technically effective, computer specialists have developed an informal, more private folklore of systems that were underused or abandoned because they were ineffective person-machine systems. Systems can be ineffective when they are not well understood by the people who use them[27], provide inaccurate data [13, 19], demand unusual precision and attention [3,20] or are difficult to modify when the kinds of information users want changes [11].

These difficulties can undermine the utility of a computer system even when its users are relatively homogeneous and welcome computational assistance. When the "users" of a system have different or conflicting needs, political dynamics have an even greater impact on the use of a system than do its sheer technical qualities. Developing usable designs remains a subtle art even when the users of a system are not in conflict. The most difficult problem in many

settings is acquiring an appropriate set of specifications for data and record-keeping conventions, the kinds of manipulations desired, and the way data should be available in reports or queries.

Consider the common issue of designing the interfaces for entering, retrieving and reporting data from an information system. If one valuable byproduct of automation is the creation of jobs which are less alienating [32, 33], then gratifying interfaces between a computer system and its users is an essential ingredient of any "successful" system. During the past decade, systems have largely been designed from the "inside" out [20]. Substantial attention is paid to efficient and elegant code. The interface with the user is usually designed last to match the "internal" system. Substantial know-how has been acquired in the construction of various efficient algorithms [15] and the majority of studies in computer science caters to such concerns [29]. In contrast, we have relatively little systematic knowledge regarding the design of good user-oriented systems. Consequently, analysts with conventional training are biased towards neglecting the person-machine interface.

During the last 5 years, there has been increasing attention to "designing for users". [11, 18, 19]. However, the conditions that foster designs "for users" are poorly understood. The most common prescriptions to support user-centered designs focus on involving users in design teams. However, the conditions under which such participation will be substantive rather than symbolic are rarely specified. In addition, the kinds of understanding communicated by users when they participate in design teams are rarely made explicit.

This paper develops a framework to predict the conditions under which designers are likely to develop user-centered systems.

Methodologies for Computer System Design

The prevailing norms of computer system design are machine-centered (Table 1). Functional designs that focus upon direct effects, such as increasing the ease of generating reports, are highly prized [13, 28] while indirect impacts tend to be ignored [11]. For example, Bjorn-Anderson [5] recently reported a study of six banking systems which had a complex pattern of impacts on the work of clerks and managers who used them. Some systems increased the variety and scope of their users' work while others led to more constrained and repetitive jobs. In each case, however, the designers expected their computer systems to have no effect on the jobs of their users. The actual impacts were simply unintended. Typical systems are evaluated by their impact on information flows [33], the logical organization of the functions they perform [28] and narrowly defined cost-effectiveness [6].

SEE TABLE 1 - PAGE THREE A.

Emphasizing these criteria are policy decisions, not simply technical decisions. Computer scientists can measure the computational efficiency of an information system; organizational psychologists can tap job satisfaction [24] and satisfaction with computing systems [17]. Both sets of criteria can be operationalized. The deeper issue is deciding which criteria are relevant to the design

MACHINE CENTERED

1. Efficiency is emphasized.
2. Systems are designed in purely functional terms.
3. Human error is not tolerated. Systems are not error tolerant and provide limited diagnostic information.
4. Users are forced to match the precision required by the machine.
5. Jobs and procedures are designed to simplify machine processing.
6. Human relations are ignored as long as the job gets done.
7. System designs are imposed on users. They initiate but never veto system designs.

USER CENTERED

1. Systems are valued that increase personal competence and pride in work.
2. People are accepted as non-rational and error-prone.
3. Jobs are designed to be personally satisfying. Automated procedures are designed to fit job needs.
4. The burden of precision is placed on the machine. Systems are forgiving.
5. Users easily obtain/create systems that meet their needs.
6. Users can initiate, veto, and collaborate in system designs.
7. Designs and assumptions are intelligible to users through appropriate technique (modular structures) and clear documentation.

TABLE 1

SOME CHARACTERISTICS OF MACHINE AND USER CENTERED ENVIRONMENTS

and implementation of computer-based systems so that the systems will be effectively utilized and enhance the work environment of the people who use them. Recent studies indicate that both technical and "social" criteria influence the success of computer-based systems[17, 18]. Systems which are poorly designed or do not meet the actual needs of their users are not effectively utilized. Nor do they satisfy the people who use them.

During the last several years, concern for the "needs of computer users" has become commonplace. Several investigators have developed specific procedures to help insure that software designs will meet the needs of some of the people who use computing* [3, 17, 18, 19, 20, 23, 26]. These proposals vary in emphasis, comprehensiveness and likely effectiveness.

Some analysts emphasize the technical characteristics of the interface between a computer system and its users. Both Martin [20] and Coles [3] limit their attention to interactive systems which allow some dialogue. Coles focuses upon the problems of providing users with a comfortable natural language interface. In particular, he emphasizes that novice and expert users of a particular system require substantially different interfaces. Martin's handbook [20] presents detailed guidelines for the technical development of useful and intelligible dialogues between machines and their users. He proposes specific solutions to specific problems, e.g., printing back input to

* we explicitly ignore programming methodologies such as structured programming. These are of interest to the extent that they produce programs which optimize "user-centered" features such as modifiability.

aid in detecting errors when data is entered. Both Martin and Coles attend to the different needs of naive and sophisticated users; both attend to the needs of hypothetical terminal operators.

The richest set of criteria for "humanized designs" appears in the Stanley House Report prepared by Sterling [34]. It explicitly considers all the people who come in contact with an information system as worthy of careful attention during design -- whether they are managers, clerks, an organization's clients, or data subjects. Twenty-five guidelines for designing systems are presented that deal with users, with exceptions that arise during the course of system's use, with problems of information control, with privacy, and with aspects of a system that have a bearing on ethics. These guidelines range from cosmetic features ("Transactions with the system should be courteous") through technical requirements ("There should be procedures to correct errors," and "The system should give people choices on how to deal with it") through organizational policies ("A procedure must exist to override the system"). While these guidelines are quite general, they place a sufficiently clear set of constraints on a system that one can judge at least whether a particular system follows each guideline. In addition, these guidelines explicitly treat an information system as part of the larger organization in which it is embedded. Thus, whether or not people have choices in the ways in which they deal with an information system focusses upon what choices are available rather than whether they are automated.

Unfortunately, the approaches proposed by Martin, Coles, or the Stanley House Report fail to deal with the process by which the actual users of a computer system are identified and the variety of their particular needs ascertained and then negotiated into the design of a particular system (including its associated organizational arrangements).

Some analysts note that the needs of computer users vary from situation to situation. For example, Orlicky's [26] proposals are written for a business manager who is relatively unfamiliar with computers. His 12 criteria for implementing system design include "Keep service to user uppermost in mind." This concern is elaborated in several suggestive proposals such as using English instead of mnemonic programming codes on output forms. He also suggests that users be invited (or forced) to participate in system designs. However, he neglects to specify the actual influence that users will have upon the resulting design. He simply doesn't distinguish between symbolic participation and substantive influence.

The most sophisticated design strategies have been developed by investigators such as Lucas [17-19], Hedberg [8], and Mumford [9] who have carefully studied the ways in which computer users may inform designers about their wants and needs with some precision and clarity. Lucas suggests that designers should regularly tap the perceptions and satisfactions of clients with the computer applications they use. His survey technique includes a questionnaire that indicates a respondent's perceptions of (a) the computer system, including its ease of use and the quality and usefulness of the information it

provides and (b) the quality of service provided by the computer staff.

Mumford reports an even more ambitious approach which is now in process in several British firms. She has elaborated a "needs-fit" theory of job satisfaction which she uses to probe for areas of computer impact that might effect the job satisfaction of employees in a computer using department. Her theory assumes that each employee has certain needs such as to be equitably rewarded for the work performed; to use and develop his skills; to secure particular levels of achievement, recognition, responsibility and autonomy; and to work in accord with his own ethical and social values. In contrast, different jobs offer different opportunities to satisfy each of these needs. "Job satisfaction" is measured as the quality of match a particular job provides to a particular person along these various dimensions*. She uses a questionnaire to tap employee job satisfaction, attitudes toward change and attitudes toward a new computer system in a department which wishes to automate some of its procedures. This data is analyzed and used to identify those dimensions of job satisfaction that many employees are well satisfied with and that the automated system should not disturb. In addition, those dimensions with which many employees are currently dissatisfied are identified and analyzed to see how the (new) computer system might produce a better fit between employee needs and job characteristics. These analyses are discussed with the organizational management, department employees and computer staff. Unfortunately, Mumford's

* This capsule summary just hints at the richness and structure of Mumford's theory. The interested reader is directed to her accounts for additional detail [23, 24].

recent description of this process [23] argues for its value without describing its limitations.

Lucas hopes that the information collected by designers will shape their designs rather than be ignored or used to co-opt users. However, he doesn't characterize the organizational context in which data collection is meaningful and will actually shape system designs. For example, there is evidence that when users are simply requested to supply information to aid in the design of a system they do not understand, they may sabotage its use or development [1, 26]. In contrast, Mumford's emphasis upon job satisfaction and extensive consultation with employees assumes that the computing staff and management are willing to shape a new system in accord with these concerns. However, Lucas' evaluation of specific system features by users provides concrete design information that is unavailable in measures of job satisfaction. Well informed designers need both kinds of information.

The Politics of Software Design and the Concept of "User"

The difficulty of talking about software designs and "users" is compounded by the tremendous variation in the scale of the social settings in which computing is used. Some applications may be used by one person. Other applications such as airline reservation systems, bank-teller systems [8], and welfare information and referral systems [13] may be used by dozens of managers, thousands of clerks, and tens of thousands of citizens who act in hundreds of different social settings. Between these dramatic extremes are the bulk of computer

applications which are used by dozens of managers and clerks in several different work groups within complex organizations. "The user" is merely a convenient linguistic fiction which helps simplify one's syntax and implies a kind of homogeneity and consensus which makes a system design appear legitimate [14].

The actual demands that different users and consumers place upon an information system range from those that are sheerly conflicting, to others that are complementary, compatible, or indifferent. When the users of an information system are engaged in a specific social conflict, an information system should be viewed as a instrument in that conflict and the designers viewed as political agents [12]. For example, when a top manager initiates a cost-accounting or time-reporting system to help him gain further control over slack resources, the resulting information may best serve him, even though many other managers and staff are using it to keep records and receiving specialized reports from it. Increasing the control over slack resources by one manager diminishes the extent to which lower level staff can control those resources. In such a situation a designer cannot simply meet every "user's needs" since they may be in sheer conflict*. The approach to software design developed in this paper presumes that the diverse users of a computer system are not engaged in a sufficiently profound and pervasive set of conflicts that cooperation is infeasible. Negotiating cooperation among computer

* Such examples are commonplace, but not dominant in many computer-using organizations. For a careful study of the ways in which automated information systems enhance the control of top executives over department heads in American local governments, see Kraemer and Dutton [16]. For an extensive account of the politics of design, see [36].

users with incompatible interests entails some organizational politics [10].

However, when there is little manifest conflict between the users of a computing system, a variety of needs may be met in a single system. Consider the example of municipal accounting and budgeting in the U.S. Most cities segregate their revenues into dozens of specially labelled funds such as property taxes, state grants, and parking fines. Some cities, such as Kansas City have over 100 funds. The budgets of each department are drawn from specific funds. Accounting staff are particularly concerned that no fund be overdrawn and organize their ledgers and budget reports "by department, by fund." Department staff and budget officers, on the other hand are more concerned with the total funds available in certain line-item accounts rather than the way those accounts are distributed across various funds. However, many automated municipal ledger systems produce budget summaries for departments separately for each fund. Department staff often hand tally several fund-specific reports to learn what their actual balances and expenditures are. When these ledgers were originally automated, "the user" often referred to accounting staff, even though many other people's needs could easily have been accommodated. Even second generation machines could add across funds as well as within them.

Examples of designs which accommodate the needs of only a few people or groups that use a computer-based system are legion. They typically occur where an information system serves several departments or staff with different responsibilities and work demands.

Investigators such as Hedberg, Lucas, and Mumford stress participation by a variety of users in the design of information systems to ameliorate these difficulties. However, Hedberg [8] notes that apparently broad participation may be merely symbolic. Symbolic participation is most likely when the participants are drawn from geographically dispersed work groups and have little time to devote to either travel or understanding and altering the design proposals developed by computer specialists. But even symbolic participation is still not widespread. Table 2 presents an a portrait of the ways that users are currently involved in computing design in a large sample of American local governments.

[Move TABLE 2 Here from End of Paper.]

According to the self reports of computer specialists users never or seldom review designs for computer applications in 25% of the cities and counties in the survey. Based on field studies in several dozen American local governments carried out over the last three years, we find that users are often in weak positions when negotiating with service providers. There is bias in these self reports; computer specialists usually overreport the level of involvement that users play in decisions about computer use. In this sample, the median number of applications automated was 40; staff in these governments are familiar with automation. Thus we find this data particularly revealing.

It is tempting to view this data as indicating that computer specialists are more interested in serving their own interests and conceptions of computing than providing a service to their clients [4]. While there is much to be said for this view, it simply opens the question of what computer users may do to insure that software designs meet their needs.

It is tempting to ask what kinds of incentives or organizational arrangements might promote the active participation of computer users in the designs of systems they will use. However, "user involvement" is merely one policy among many that may foster user-centered designs. We take a different approach by asking: what kinds of personal characteristics of designers and organizational characteristics foster the development of user-centered designs? Our answers to this question will help develop a set of policies that to foster user-centered designs.

Framework

In this section we develop a framework to help us theorize about the conditions under which software designs will be particularly user-centered. The framework includes both characteristics of the designer (e.g. his values) and of the organizational context in which computer systems are designed and implemented. The framework specifies both the personal characteristics of designers and the organizational settings in which they work by a few constructs:

Personal Characteristics

- (i) Technical competence
- (ii) Designer values

Characteristics of the Organizational Setting

- (iii) Salience of consequences
- (iv) Salience of responsibility
- (v) Management support
- (vi) Resources (time and money)

we believe that user-centered designs are unlikely to be developed routinely by design groups which work in organizational settings that are not characterized by the features listed above. For example, if a technically skilled designer who wishes to develop a user centered system has little awareness of the consequences of his design alternatives for his users and few resources to spend in finding out, then it is unlikely that the system he designs will be especially tailored to the needs of its particular set of users. This may sound obvious and even tautological. But note: the design methodologies developed by computer technologists emphasize a set of techniques for engineering appropriate data structures and an interface between a system and its users. Organizational psychologists emphasize involving users in design. Each group neglects (or takes for granted) the resources and management support they require, as well as the activities emphasized by the other. This framework makes these elements explicit. Each element is examined in this section. The next section proposes several policies to deal with the more problematic elements (e.g., management support).

Technical Competance

In the remainder of this paper we assume that a designer is competent to carry out the technical aspects of his job. Designers of similar skill will develop different designs. We are interested in the non-technical factors that influence the shape of their designs.

Designer Values

Software designs are often under-specified; designers have tremendous freedom in shaping a design in accord with their own technical preferences and understandings about who computer users are. But we know very little about the perceptions that computer specialists have of the users they serve and the ways in which they translate those perceptions into concrete designs. Hedberg and Mumford [9] report a study of the "model of man" held by a sample of Swedish and British designers. They found that designers had two quite different models of people in organizations. One model which was elicited in response to questions regarding workers in general emphasized people's desires for challenging work and self development. However, when designers were asked to characterize the people for whom they designed computer systems, they portrayed the computer users as limited, conservative people who work with a limited set of skills and who are extremely resistant to change. There were also cultural differences in the study: Swedish designers viewed both workers in general and computer users in particular as seeking more challenge and being less constricted than did British designers.

To increase user-satisfaction, should the manager of an applications programming group simply hire staff who want the systems they design to be satisfying tools? A recent study of control panel designers [21] showed that they held a set of priorities very similar to those of human factors experts. They were asked to design several simple control panels and their designs were evaluated. Surprisingly, the concerns they voiced for easy use and maintenance simply were not embodied in their designs. They felt that human factors criteria were "obvious," disregarded available data on parameters for humanly effective designs, and created products which were ill-conceived from the point of view of their ultimate users. Articulated values, and even sincere intentions seem to be inadequate to insure appropriate designs.

Salience of Consequences

Are there particular conditions that would foster congruence between the values designers articulate and actual designs they produce? This question is an instance of the more general question: When will people act in accord with their beliefs? The common sense explanations of action that are in accord with belief are framed in terms of "strength" of belief, wanting to be consistent, rewards and courage. Recently, an experimental social psychologist has elaborated a more powerful theory to predict when a person's acts will conform with his values [30, 31]. Schwartz presents a careful set of experiments that show that the feedback a person receives about the consequences of his actions will promote congruence between his actions and his beliefs. In programming settings, organizational

structures and policies which promote clear feedback from users to designers will foster user-centered designs if the designers value them and the conditions outlined in the following sections are met.

In many organizations the applications programming staff is explicitly insulated from close contact with computer users [22]. In such settings policies which promote the participation of representative users in the design of their systems or which provide sufficient time for a designer to "get into" the work environment of the user would promote such feedback. In settings where a separate consultant group handles day to day complaints, the information that is passed onto the applications group will be highly filtered. There is some evidence that officials who can not act directly on a complaint will tend not to pass it on [35]. Similarly, a large number of complaints about a particular system may be "trapped" by the consulting group and not passed through the organization to the analyst/programmers who can act on them. Lucas' proposal for designers to directly survey user's perceptions of the satisfactions with the systems they use tries to circumvent this difficulty [17].

Salience of Responsibility

A second major factor in Schwartz's theory is the degree to which a person accepts responsibility for his actions. This may be a personal trait: some people accept more responsibility for their actions than others (ascription of responsibility), or it may be a byproduct of the job structure that particular individuals are held responsible for particular actions (salience of responsibility). In

development projects, the salience of responsibility is quite high since it is usually clear, precisely, who is responsible for which section of a design and its implementation. In contrast, programmers who maintain software developed by others are in an ideal situation to pass the buck on complaints. After all, they didn't design the program in question, they just have to modify it as best they can.

But the deeper issue common to both the situations is: To whom, and for what, are programming staff responsible?

Management Support

Computing Staff

He who pays the piper calls the tune. While people do not respond rigidly to explicit organizational incentives, the criteria used to hire, promote, raise salaries and fire surely impact behavior. Computing staff maintain (science-related) norms of preferring to work with the most sophisticated technologies available, at the "frontiers of knowledge" [24]. In addition, experience with advanced technologies aids in keeping the computing staff member from becoming technologically obsolete and remaining attractive in the job market. Computing personnel are usually hired for technical competence, and promoted for technical and fiscal success. (The latter include meeting deadlines and staying within the budget allocated.) The explicit satisfaction of users with the particular applications packages they have developed in the past is, at best, usually a secondary consideration. (Nor is user satisfaction systematically monitored and evaluated like a budget.) Without a set of incentives

that reward those members of the computing staff who value service as much as technical sophistication, it is unlikely that many systems will be designed for the actual needs of many actual users.

User Staff

The preceding discussion portrays a unilateral relationship in which designers impose systems on users. Such a relationship may prevail when designers view themselves as change agents "reforming" an inefficient organization [1]. A recent study [7] of middle managers showed that many felt little need for automated information systems. While most felt that they ought to have a large role in the design of such systems, their low priority suggests that they may provide few personal or staff resources to understand them and involve themselves meaningfully in their design. Yet meaningful "user involvement" requires time and interest. For MIS, the using manager(s) may have to care about its development the way they would involve themselves with any other major project. With automated information systems, some of the people who use it need some time released from their routine work to engage in the design of the new system. Mumford's work in the design of user-centered systems seems to take place in departments which provide substantial support for the staff to learn about alternative designs for new systems.

There is a major trade-off between the time taken to write a computer program and its user-oriented features. In a recent study [37], several different groups were asked to write programs to perform the same task. Each group was asked to optimize its program on a pair of different criteria chosen from minimum programming time, minimum run time, minimum storage space, minimum program size, program readability and output readability. (Program readability is a major factor in simplifying later modifications and maintenance.) All the programs were ranked on all the preceding criteria. Most groups ranked first on their most important objective and often performed relatively well on their secondary objective. However, groups that performed well on some of minimization criteria (e.g., minimum programming time) performed poorly on the user-related criteria (e.g., output readability). Weinberg claims that when a program is specified (in terms of its function), programmers may design it on many different (and incompatible) criteria. Some of these additional criteria are often preferred by particular programmers -- they contribute to "style." If these additional objectives (e.g., efficient run time, error protection, or output readability) are included in the program specification, then programmers may meet several of them well. Otherwise, important objectives (which are unspecified) may be treated as "free variables" and sacrificed to satisfy other less important and idiosyncratic objectives.

The common practice of letting user-related objectives "run free" is exacerbated by their neglect in the available programming time (cost) estimating procedures [2]. These procedures emphasize factors which are internal to a system, such as the number of instructions and the interdependence of subsystems, and neglect user-oriented tasks such as the time needed to negotiate a design, training users, etc. These user-oriented activities are congruent with the various estimating procedures. They are often ignored and must be included for reliable estimates of overall system cost to be made.

The major resource that user-centered designs require, aside from technical skill, is time (money) and respect for the people who will use a computing application. It takes time to find out what people need. It takes time to engineer graceful interfaces between a computer system and the people who use it. It takes time to produce documents which can be clearly understood by average (or novice) users of a new system. The scarcest resource in the computing world is time. A common script in the world of systems design emphasizes the role of time:

A client group wanted its system last month. The system is sold as "cost-effective" and must be cheap. A system promoter is optimistic and feels his skilled staff can produce a new system in months instead of years. The resulting schedule has little to do with the substantive complexity of the work to be done. Rather, it is tied to the schedules of related projects with which a system will interface, leasing contracts, and budget cycles. The resulting system is either poorly designed, or late.

whatever the variety of (related) causes, computing systems all too often are developed under tremendous time (money) pressures. If a system is not "up", it can't be used at all. Pressures to develop a rapid design and "get something up" mitigate against careful attention to needs of the people who will use it. caring takes too much time. Occasionally, policies of pricing computing services are tried as a way of giving users more say in what they get. Computing budgets may be given to each department rather than treating computing costs as overhead. However, if the computing staff has a de-facto monopoly on the provision of service, then pricing alone will have little effect on service quality. More deeply, if the available computing service providers share common norms, then there may be little to choose between.

Policies to Foster User-centered Designs

The preceding discussion outlines key features of organizations that we believe constrain the system designs that emerge from a computing group. Existing design methods emphasize either technical features or specific structural arrangements, e.g. user participation. In this account, theoretical features of organizational settings (e.g. salience of consequences) were used to make sense of the social dynamics underlying different approaches to design. Some elements of the framework developed here have been investigated in certain studies. But much remains to be done. In particular "management support" and "resources" have been neglected as either experimental or control variables in the studies performed to date. These gaps are important to fill in developing sound theories

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of the impacts of organizations on (computer) technology and the impacts of (computer) technology on organizations.

Such theory development will be relatively slow. Managers, designers and computer users need to make decisions on system development policies in the interim. The policies listed below are intended to foster less-haphazard design settings. They take a great deal for granted. They assume that staffs are skilled and stable, and that the systems being designed are well conceived.

Designer's values

(i) Allow a designer/analyst to spend ample time with users in their milieu to appreciate their needs.

(ii) If a consultant group is different from the design group, rotate designers through the consultant group.

(iii) Check with users of systems designed by a new designer when hiring new staff.

(iv) Recruit analysts from the computer-using group.

(v) Select analysts who have some training in the social sciences. Training in the ethnographic traditions of sociology which emphasize understanding the "logic" of different subcultures is much more helpful here than the psychological traditions which emphasize the individual in social isolation and treat him as a cluster of parameters.

Salience of Consequences

(i) Survey user perceptions [17]: Such a survey may range from appraisals of specific features of existing systems to perceptions of and suggestions for proposed systems. It is important that the users surveyed see that their responses actually effect the systems they are using. (Some complaints and suggestions may be captured as part of the data entry form.)

(ii) Place representative users in the design group; or, at least educate (key) users on the way a system works as well as what it does [27].

(iii) If a consultant group is different from the design group, have the consultants maintain a log of all complaints and satisfactions expressed by users. (Pass this log regularly on to the design group.)

(iv) Hold system critique sessions which include both designers and representative users [18, 24].

Salience of Responsibility

(i) Have designers place their names on systems manuals rather than simply listing group or corporate authorship.

(ii) Provide an ombudsman for organizational clients who have trouble using a system and have no easy way of identifying where there troubles could be resolved.

Management Support

(i) Include user satisfaction in the performance reviews of system designers. (This is simplified if such data is regularly solicited by some of the techniques proposed to increase the consequences of alternative designs.)

(ii) Indicate to user groups that their active involvement in system design is critical if they are to receive programs that are genuine aids.

Resources

(i) When estimating costs for a new system, include the cost of implementing any of the proposals suggested above.

(ii) The quality of the person-machine interface should appear explicitly in the specifications for a new system. Be sure that time and cost estimates include such features.

(iii) Estimate costs on a life-cycle basis (that includes the period from development through replacement by a new system).

Conclusions

During the last few years, designing "for users" has become a commonplace slogan amongst software designers. While a variety of design methods to enhance the "user-centeredness" of systems have been proposed by the Stanley House Report, Hedberg, Lucas, and Mumford, they have not been developed in a theoretically satisfying way.

This paper develops a framework to analyze the conditions under which a software design group is likely to produce user-centered systems. The framework emphasizes structural features of the organization in which design takes place as well as personal characteristics of the designers. According to this perspective, the production of user-centered systems need not be a haphazard event which is dependent of the idiosyncratic play of the particular people who develop and use each system. Rather, by understanding the organizational setting in which design takes place, one can predict the likelihood that user-centered designs will be developed on a routine basis. The framework was used to develop a set of policies that are likely to increase the frequency with which a design group will produce software that meet the needs of its various users. These policies include both traditional approaches such as "involving users" in the design of software, and also a wider array of policies to promote sharpened responsibility and clear perceptions about the impacts of alternative software designs.

Table 2

Participation of Computer Users in Data Processing Activities*

Percentage of installations
Indicating that users participate

<u>Activities</u>	<u>Never</u>	<u>Seldom</u>	<u>Often</u>	<u>Always</u>
A. Participate as members of a design team.	17	24	44	15
B. Perform systematic analysis of benefits and costs anticipated from a proposed computer application.	23	48	21	8
C. Review designs for a new application	6	19	36	38
D. Provide test data for an application	19	35	31	15
E. Sign off, accepting an application.	26	27	24	23
F. Provide informal feedback on problems with the data processing unit.	05	15	49	31

* Question: "What is the frequency with which users of your data processing unit do each of the following?"

* Based on a sample on 473 cities and counties from a survey administered in 1975.

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