Human Relations, Volume 40, Number 3, 1987, 153-162

Principles of Sociotechnical Design Revisted[1]

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This paper is a review of the author's 1976 "Principles of Sociotechnical Design." While most of the principles set out there have stood the test of time and experience, modifications are needed. In particular, the principles that govern the process of design and the activities of the design team are even more closely bound up with the principles governing the design itself. Some new principles are proposed. More attention is given to the needs of the organization as a society.

INTRODUCTION

After 10 years, it is not unreasonable to review the paper entitled "Sociotechnical Design" first published in *Human Relations* in 1976 (Cherns, 1976). At that time, there was sufficient experience with new organizations and the redesign of old ones to provide some confidence in the principles that had emerged. The paper itself have been reprinted in a number of compilations and has received wide circulation. Time, however, does not stand still; experience has accumulated. Too few full accounts of the designing of organizations have been published. Lectures, workshops, meetings, and case study presentations abound. Clear divergences have appeared and hardened between Scandinavian and North American approaches and applications. And while the techniques of sociotechnical analysis have been refined and improv-

[1]I am indebted to my colleagues in Sociotechnics International and to generations of students of our workshops, formerly under the aegis of UCLA, for the stimulus to review the earlier article, and especially to Lou Davis for his suggestions and ideas.
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0018-7267/87/0300-0153$05.00/1

ed they have also tended to become rigid; their demand for considerable effort and understanding have led many to abridge them or to seek tempting short cuts.

Furthermore, the techniques were originally evolved by social scientists for their own use in analyzing and designing organizations. The last decade has seen the realization that the basic data that are needed belong to people, and that they themselves should be involved in the collection and the analysis for two reasons. First, much of the data will otherwise be unreliable and wrongly interpreted; secondly, conclusions from those data in the form of design or redesign will otherwise be only weakly accepted. In targetting engineers as designers of organizations, we sought to provide them with a new perspective, better understanding, and some guidelines so that they could better design organizations as social systems. But, although the "Principle of Compatibility" was placed at the head of the list emphasizing that only participative design could lead to a participative organization, I failed to follow the implications through in the remaining principles. Davis (1982) brought together process and principles and his statement is required reading for anyone who needs to understand just what organization design is and involves. My aim here is different; no one reading this will have all he or she needs to know to understand the whole process or to initiate it. But he or she will be able to assess how appropriate is a given design to the objectives stated for it. And for those involved in design, it is both an aim and a checklist. As for its predecessor, I make no claim for completeness; if anything, I am uneasy that I have not felt the need to amend more, and I hope the next 10 years will teach me more. In this spirit, I offer this revised list.

Principle 1: Compatibility. Everyone can assent readily to the notion that means should fit ends, that the way in which design is done should be compatible with the design's objective. The statement that a design should be "participative" is either too readily accepted which suggests that its meaning has not been fully taken, or dismissed as impractical. How can you involve everyone in design? Surely design is a job for designers. We have to spell out more clearly just what this principle involves. One notorious example of gross misunderstanding is the inevitable failure of a manufacturing company's attempt by way of setting up a "Participation Department"; it is an illustration of the bureaucratic approach, a bureaucratic instrument to de-bureaucratize. From the outset we must recognize that design is an arena for conflict. It has to satisfy an array of objectives, each represented by some organizational element; the way in which this conflict is managed and used to yield positive results sets the pattern for the handling of subsequent conflicts in the newly designed organization. Thus, the design team has to work on its own process and principles of operation, principles no different from

those which guide its design. Majority rule, horse trading, or power plays are unacceptable. Members must reveal their assumptions and reach decisions by consensus. Joint "optimization" of technical and social systems is often wrongly interpreted as modification of a technical design for social considerations. It is joint design in which each decision is reached for both technical and social reasons. Experts are needed, whether members of the team or invited for specific issues. But they, too, are required to reveal their assumptions for challenge; for some experts, this is a shock. How they deal with it is at least partly a function of how well the team has prepared them. Again, since the outcome desired is one in which all organizations work together to the same objectives, none can be omitted from the team. And whoever represents a function should truly represent it, which means that he or she is obliged to consult and inform his or her colleagues.

The principle of compatibility is truly the first principle; how well it is adhered to determines how well the remainder can be followed.

Principle 2: Minimal Critical Specification. As stated, this principle has in my view stood the test of time and I can do no better than repeat it. This principle has two aspects, negative and positive. The negative simply states that no more should be specified than is absolutely essential; the positive requires that we identify what is essential. It is of wide application and implies the minimal critical specification of tasks, the minimal critical allocation of tasks to jobs or of jobs to roles, and the specification of objectives with minimal critical specification of methods of obtaining them. While it may be necessary to be quite precise about what has to be done, it is rarely necessary to be precise about how it is done. In most organizations, there is far too much specificity about how and indeed about what. And a careful observer of people in their work situation will learn how people contrive to get the job done in spite of the rules. As the railwaymen in Britain have demonstrated, the whole system can be brought to a grinding halt by "working to rule." Many of the rules are there to provide protection when things go wrong for the man who imposed them; strictly applied, they totally inhibit adaptation or even effective action.

In any case, it is a mistake to specify more than is needed because by doing so, one closes options that could be kept open. This premature closing of options is a pervasive fault in design; it arises, not only because of the desire to reduce uncertainty, but also because it helps the designer to get his own way. We measure our success and effectiveness less by the quality of the ultimate design than by the quantity of our ideas and preferences that have been incorporated into it.

One way of dealing with the cavalier treatment of options is to challenge each design and demand that alternatives always be offered. This may result in claims that the design process is being expensively delayed. Design pro-

posals may also be defended on the ground that any other choice will run up against some obstacle, such as a company practice, or a trade union agreement, or a manning problem. These obstacles can then be recorded and logged as constraints upon a better sociotechnical solution. When they have all been logged, each can be examined to estimate the cost of removing it. The cost may sometimes be prohibitive, but frequently turns out to be less formidable than supposed or than the engineer has presented it to be.

Again, it is vital that experts and team members reveal their assumptions for challenge. These often turn out to be assumptions about people, that there is one class of person capable of a category of tasks: a maintenance task requires a maintenance mechanic, a cleaning task requires a cleaner, and so on. If we end by assigning a team to a set of tasks which make a coherent whole, we can leave, until the team is recruited, the way in which the tasks should be carried out and who is to do what and when. The extent to which teams can assume responsibility given the right conditions surprises even those who wished it.

Principle 3: Variance Control. In my original formulation, I gave this the somewhat pretentious name of "the sociotechnical criterion." The principle has survived the test of time, but the old title indicates that I held too narrow a view of "sociotechnical." True, the principle that variances should not be exported across unit, departmental, or other organizational boundaries is crucial to successful organizational design. True, also, it is the most closely related to the process of sociotechnical analysis; the variance control table brings into immediate prominence inefficiencies in the orgnaization's mode of controlling key variances and prompts suggestions for its improvement. But sociotechnical analysis does not end with the variance control table, important though it is. The social system is more than an effective system for control of technical and raw material variances. And this principle of variance control is very closely associated with Principles 4 and 5.

Principle 4: Boundary Location. This was formerly Principle 5, but because of its relationship to principle 3 should come immediately after it. Its essential feature is that boundaries should *not* be drawn so as to impede the sharing of information, knowledge, and learning. The example I gave was of drivers whose departmental organization effectively prohibited their passing on their knowledge and learning about customers and routes to the routing clerks. Many others come to mind including one in a recent design where the location for good practical reasons of two process controllers on the other side of a wall from the process they controlled, placed them, for bad theoretical reasons, under the control of the supervisor of a totally different function. This created a control and information loop which delayed corrective action and promoted endless, if minor, conflicts.

This kind of misplacement arises sometimes from the overvaluing of the merits of tidy geographical commands, sometimes for fear of the advan-

tage that "unsupervised" workers may take. That is less surprising than the willingness to live with what everyone recognizes as indefensible anomalies; there is a perverse pride in organizational "nonsenses." Sociotechnical analysis quickly reveals the confusions of "ownership" which plague existing departmental boundaries.

Principle 5: Information Flow. The principle of boundary location counsels against, if it cannot absolutely prohibit, the interruption of information or the insertion of information loops by misplaced organizational boundaries. That by itself will not, however, ensure that information is provided to those who require it when they require it. Obstacles are vertical as well as horizontal. In my observation, information in organizations has three uses: for control, for record, and for action. Its use for *control* of behavior is pernicious, with its associated power games. Its use for *record* is essential but abused. Information systems that provide management with comprehensive and detailed information of the operations constitute a virtually irresistible temptation to intervene, to harass, and to usurp subordinate control and authority. Information required for record should be readily available for call only when and as needed. Information for *action* should be directed *first* to those whose task it is to act. This holds for action to control variances; it holds equally for action to discharge all the actor's responsibilities: for safety, waste control, planning cost control, etc. It is no use holding an individual or a team responsible for any function and doling out information about its performance in arrear and through a higher authority. Under those conditions, the individual or team cannot have ownership of the performance.

This principle is consistent with the need, now increasingly accepted, for information systems to be designed in cooperation with their primary users so long as the designer recognizes that the primary users are those who need to act on the information as well as those who are required to provide such information as is not automatically registered.

Principle 6: Power and Authority. Louis E. Davis has coined the term "work authority" to describe two linked concepts. Those who need equipment, materials, or other resources to carry out their responsibilities should have access to them and authority to command them. In return, they accept responsibility for them and for their prudent and economical use. They exercise the power and authority needed to accept responsibility for their performance. But there is also the power and authority that accompanies knowledge and expertise. Confronted by forest fires, authority and power are granted in the U.S. Forest Service to whoever has the knowledge and experience regardless of rank and post; the Admirable Crichton principle.

Principle 6 is closely associated with Principle 5. The diversion of information seduces top management into assuming command of fire fighting, often by remote control. If top management possesses the relevant knowledge and skill, learning and the acquisition of self-confidence are denied to those

where the action is. If top management does not possess those attributes, the result is failure, buck passing, and resentment on all sides.

Principle 7: The Multifunctional Principle. In my original formulation, I trapped myself with too philosophical an account. Consequently, it has been poorly understood and weakly interpreted. The distinction between mechanism and organism *is* relevant, but too metaphorical; an organization is neither one nor the other and concepts like "equifinality" and "directive correlation" are, for all their power as intellectual tools, too remote from organizational concerns as understood by design teams. A more earthy conceptualization is more help.

Organizations need to adapt to their environments; elements of organizations need to adapt to their environments of which the most important are usually other organizational elements. There are two ways of doing so, either by adding new roles or by modifying old ones. (The mechanism adds another specifically designed gadget, the organism learns a new trick). Hiring specialists, experts, is the mechanical response; training to enlarge the repertoire is the organic. Experts add to the problems of organizational integration in many ways; they add to the line–staff confusions of authority; they acquire regulatory as well as advisory functions which add paper work and recording and establish standards which can become disfunctional. The expert as trainer serves the organization quite differently; his role is to enlarge the roles and, hence, the response repertoires of individuals and teams without complicating the lines of command or the allocation of responsibilities.

Principle 8: Support Congruence. The implications of sociotechnical analysis and design are comparatively readily accepted for production, maintenance, and quality control. But the support of production teams implies significant and far-reaching changes in reward and information systems, in financial control, and in marketing, sales, purchasing, and planning. At best, each production unit can operate as a profit center; that conflicts with many finance departments' views of financial control. How much control can be exercised by production teams over purchasing, and how much influence they should exert on marketing and sales policy are questions which raise major design issues. You can either start with existing policies and see to what extent they can be modified, or you can adopt a more radical approach; you can design the ideal system to enable production units to operate as "mini-factories" and then modify that to meet practical and policy considerations. The latter conforms better to Principle 2, start with as little baggage as possible, adopt a constraint-free design mode, and build in the unavoidable constraints later. Those may be imposed by government regulation, by corporate policy, or by practical and geographical limitations.

Reward systems offer less problems; common to virtually all sociotechnical designs is the principle of pay for what you know rather than for what you do. Particularly with high technology, the operators' knowledge

and understanding of the process is vital; they are there to monitor and initiate corrective action to safeguard production, process, and equipment. Their errors or omissions, their failures of comprehension and anticipation are costly and can be calamitous. Their value is what is in their heads.

Principle 9: Transitional Organization. Experience since 1976 is responsible for the addition of this principle. Greenfield sites pose the issue of managing start-up. Redesign on existing sites pose far greater problems; how to maintain production on the old plant while training people to operate the new, and during start-up. In either case, there is a period of transition which requires planning and design; the transitional organization is both different and more complex than either old or new.

As we are engaged in change from a traditional to a new organization, from a traditional to a new philosophy of management, from an old to a new system of values, we need to see the design team and its process as a vehicle of transition. Its design process embodies the new values, its membership constitutes a cadre for diffusing those new values through the organization. Its role in selecting and socializing the new leadership is vital.

The treatment given to those who will not have a part in the new organization, the model of selection of those who will, and the training they receive, all demonstrate the reality of the espoused philosophy. The principle of compatibility is nowhere more in evidence than here.

Facing the task of selection, management too easily resorts to tests and to the use of categories, especially where fewer will be needed to man the new. It is surprising how much realistic self-selection takes place, especially where opportunities are given for people to acquaint themselves with the kind of tasks that will be needed and where they are invited to undertake preliminary training by signing up for courses at local educational establishments. Tests where used should be employed for counseling rather than as hurdles. Those who will no longer be required should be offered help in the labor market. All this is part of the design for transition. Start-up and its debugging should be planned and designed to enhance training; too often the operatives are brushed aside while "experts" manage start-up. A vital learning opportunity is missed in the anxiety to get rolling. Managing the stresses of start-up and shut-down can be prepared for, and that is a task for the design team.

Principle 10: Incompletion or the Forth Bridge Principle. Back to the drawing board. Although the myth of stability is essential to enable us to cope with the demands of change, we all know that the present period of transition is not between past and a future stable state but really between one period of transition and another. The stability myth is reassuring but dangerous if it leaves us unprepared to review and revise.

Implementation must begin with the start of design; the principle of compatibility foreshadows this. And with implementation comes evaluation. Sociotechnical analysis reveals the key variances which must be controlled,

and training fosters the capacities to manage those which cannot be eliminated; together, they provide the criteria for evaluation, how well the variances are controlled.

Redesign is not the task of a special design team; it is the function of self-regulating operating teams provided with the techniques of analysis, the appropriate criteria and the principles of design. We place a great deal of emphasis on the training of operating teams; not only have they to learn the appropriate operating skills, they have to learn to operate *as a team,* they have to learn how to handle the information of all kinds that their self regulatory function requires, and they have to learn to review and evaluate their performance and to negotiate redesign.

VALUES

In my 1976 paper I included as my principle 8 'Design and Human Values'. But human (and social) values underpin all of these ten principles. At an early stage of sociotechnical design, a steering committee representing all top management functions, the body which mandates the design team, develops and promulgates its statement of Philosophy enunciating the values with which it charges the design team. These values spell out what the 'socio' in 'sociotechnical' means.

Typically some version of the Emery-Thorsrud 'characteristics of a Good Job' are included, providing people as individuals with challenge, variety, scope for decision making, social support and recognition, social relevance (of the job to life outside), future and an element of choice. They incorporate an understanding of what most people want from work. People do not all share the same wants or needs or expectations. Nor can all be satisfied. What can be done is to apply principles and values with understanding of, and respect for, individual differences.

An organization's responsibilities go beyond those to its members as individuals. As a society, it must have mechanisms for resolving conflict, for ensuring fairness of treatment, which will be accepted as fair, and for generating and maintaining commitment to its goals as an organization. And an organization has responsibilities to all its stakeholders, its members, its customers or clients, its suppliers, its shareholders, the unions which represent its members, and its community. These will all be included in the statement of philosophy, but none is so difficult to define as the last. Some obligations are defined and sanctioned by regulation, ranging from control of pollution to the employment of handicapped people, others call for a conscious social policy. Such a fundamental design question as location raises an issue of social policy; do we seek a greenfield site free of any commit-

ment or do we re-develop in our own community. Familiar in discussion of the "Southern Strategy" of many firms in the USA, similar questions arise in Britain where loyalty to the declining "old" industrial communities is sorely strained.

Questions of value and social responsibility can appear to take us far from the central topic of this paper, the principles of sociotechnical design, but that reflects our tendency to be preoccupied with the design, the organization as an operating system rather than as an open social system with economic goals.

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BIOGRAPHICAL NOTE

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