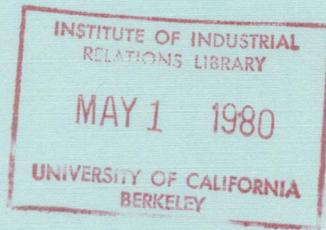CQWL

EMERGING OPPORTUNITIES
IN WORK SYSTEM DESIGN
by
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SUMMARY

    We must recognize that current methods of inventing organizations
are becoming increasingly dysfunctional. If effective strategies for
survival are to be developed, managers and designers of industrial
organizations will have to accept the obligation to examine existing
assumptions and to face the value issues involved regarding people and
technology. Existing jobs and organizations need to be restructured
to meet the requirements of a growing rate of change, combined with
increased technological development and changing aspirations and ex-
pectations on the part of the workforce. Work organizations must be
regarded as sociotechnical systems, whose effectiveness can be optimized
by jointly considering both the needs of the people together with those
of the technical processes involved.

EMERGING OPPORTUNITIES IN WORK SYSTEM DESIGN

By John J. Cotter

Introduction

The prevalent concepts of work design are still based primarily on
the ideas of Frederick Taylor, who introduced the concept of Scientific
Management to American Industry about 1910. The essence of Taylor's phi-
losophy was that the whole work process should be put together in "the one
best way" by building it up from elements, which have previously been sci-
entifically studied and reconstructed. As a matter of simple efficiency
people performing given tasks under this method perform at the limit of
their capacity. Thus, the more difficult task of scientifically studying
their work may not be performed by them and has to be allocated to others
of superior skill and intelligence. In this way, ideally, a rigid division
of mental and manual labor could be achieved, and provided that workers
were paid higher wages to submit to this strict discipline, they should
have nothing to complain about. The Scientific Management approach, as
embodied in industrial engineering, can be described as a "machine theory
of organization" and can be characterized as having the following elements:

1. The unit comprising the man and his job is the essential building
block of organizations; if the designer gets this part "right", then or-
ganizational structure will be correctly defined.

2. People are extensions of machines, useful only for doing things
that machines cannot do.

3. Supervisors should coordinate between people and their jobs,
as well as dealing with the uncertainties and variabilities that arise
in the work situation. Of course supervisors also need supervisors,
and this results eventually in an organization with a multilayered hier-
archy.

4. Organizations are free to use any available social mechanisms to enforce compliance and ensure stability, such as tighter task definitions, mechanical pacing of work, external supervision, etc.

5. Job fractionation reduces costs by reducing the skills of the individual. People are simply extensions of machines and using machine theory logic, the more machines are simplified, the more costs are lowered.

6. Paying attention to the primacy of the technological requirements guarantees optimum economic outcomes; conversely, satisfying the requirements of the interrelated social system increases costs.

7. Technology, as a science, is value free; therefore, the design and planning of production technologies are also value free.

An early reaction to the scientific management philosophy of fitting men to machines resulted in the Human Relations movement, which endeavored to meet people's social needs in the work environment without doing anything about the nature of the work itself. However, as Davis[1] notes:

> Characteristically, present production organizations are based to a larger degree on the machine theory of organization in which interdependence between tasks and between individuals is controlled by special managerial arrangements, systems of payment, etc.....
> In such organizations, thinking, planning, coordinating and controlling are functions exercised within the superstructure; transformation tasks, most of which are programmable, are performed at the worker levels..... Characteristically, management is reinforced in its beliefs that workers are unreliable, interested only in external rewards, and regard their work as a burden to be set aside at the first possible opportunity. Largely, this is a self-fulfilling prophecy. What saves the day is that the organizational system can be maintained...as long as the technology remains deterministic and social expectations for a humane quality of working life are not too widespread.

Changes in Society

However, changes in American society in recent years reflect a rising level of expectations concerning material, social and personal needs. According to the results of recent polls, our working youth now stress a new definition of success, where the emphasis is on self-fulfillment and quality of life, as well as on money and security. The nature of the payoff for hard work has changed and increasingly young people are emphasizing

rewards that go beyond economic security. This must be a matter of serious concern to the society as a whole since these young people are entering the labor force at the rate of 3 million a year.

Higher Educational Levels

The Department of Labor projects that the population of high school graduates in the adult civilian labor force will increase by 50% (from 27.8% to 41.3%) over the period from 1960 to 1985. Those with four years of college will double during this same period (from 10.2% to 21.2%). These younger, better educated workers are increasingly calling for the right to take part in decisions that affect their occupation and decreasingly see justification for a power structure which assumes that only those at the top of the hierarchy are competent to make decisions.

Lack of Opportunity

The majority face the prospect of growing difficulties with their jobs, compounded by the confrontation of higher expectations with lower opportunities. The Department of Labor, as well as the Carnegie Commission on Education, projects that as many as 2.5 million college graduates will be unable to find college level jobs during the 1970s. This may result in a bumping phenomenon, whereby these graduates will displace other workers, who will then have to accept jobs beneath their level of competence. The result will be an increase in frustration and dissatisfaction on the part of a large segment of the labor force.

Rising Affluence

As incomes have increased, people's attention has tended to shift from satisfying their basic security-related needs toward structuring experiences (including work) that are involving and satisfying in terms of human and psychological needs. This has resulted in a growing emphasis on intrinsic rather than extrinsic job rewards, and the traditional management carrot-and-stick approach to worker motivation has been found to be less effective than in the past.

Increasing Welfareism

It is becoming increasingly accepted that the right to employment should be guaranteed by the Federal Government. Unemployment is thus viewed as the result of inappropriate economic stimulation on the part of the government, rather than reflecting on the merits of the individual workers involved. Improved financial benefits also act to minimize the financial penalties previously incurred by those who were without work. Under these circumstances, people who are dissatisfied are more inclined to reject their current jobs and to seek more satisfying experiences elsewhere.

Rising Absenteeism

Absences for illness (real, or falsely claimed), as well as those from the "all other reasons" categories have been rising in the United States at an annual rate of 2.8% since 1957. By official estimates, man hours lost as a result of such short-term absences averaged 44 million hours a week in 1972, or 1.5% of the potential man hours available from the full time labor force. An additional 59 million hours a week were also lost from full-week absences. Compared to the 1960s, there has been a 15% increase in absenteeism due to illness, with semiskilled factory workers and laborers ranking highest among occupations. It is interesting to note that during the recent recession, these trends remained unchanged although employee turnover dropped considerably.

Political Considerations

In general, organizations tend to be stable only when their internal patterns of authority are congruent with those of the wider society of which they form a part. There is a growing demand for American business to recognize an incompatibility between representative democracy at the national and local level, and a system of managerial autocracy within individual organizations. Further demands for more participative democracy at the political level, in response to current abuses such as the Watergate affair will accentuate the needs for institutional change.

Changes in Technology

The rapid developments in computer technology in recent years have led to an overemphasis on technical gains at the expense of neglecting human needs and values. Sackman[2] suggests that this may be due to the manner in which computers were first used. He notes;

> The early computers were virtually one of a kind, very expensive to build and operate, and computer time was far more expensive than human time. Under these constraints, it was essential that computer efficiency came first, with people last...users were troublesome petitioners somewhere at the end of the line who had to be satisfied with what they got.

Automated technology absorbs routine activities into machines, creating new relationships between the technical processes and the people involved.

We can rank automated production systems in terms of the level of control exerted by machines as follows:

1. manual control, mechanically assisted -- continuous human involvement

2. semi automatic machines and transfer systems -- overseen by human operators

3. programmed numerical control of machine tools -- tape produced originally by human operators

4. self-correcting feedback control, monitoring a few output variables -- almost fully automatic, although limited in terms of product, requiring little human involvement

5. computer optimization of many variables -- operations almost automatic leaving human operators time to make strategic decisions

6. learning systems with advanced adaptation and "self-controlling" capabilities -- possibly able to make strategic decisions and develop management policies.

The lower levels of automation have tended to impact on mass and batch production, while the higher levels (up to levels 4 and 5) relate more to process production. Although some aspects of mass production can often be coordinated by computers, the basic nature of the product and the machines available for production determine the degree of automation that is possible in a given industry. Automation and mechanization are much less common in industries which mass produce individual items or systems, as opposed to chemicals, fluids and the like. The latter are usually amenable to automated

continuous process production. However, even with discrete unit or batch production, it is increasingly possible to mechanize individual production operations and to integrate these activities into a quasi-continuous process. Numerical controlled or self controlling machines can be used to produce particular units, and transfer machines can be arranged to move these parts on to other machines, approximating the continuous production of process plants such as oil refineries. Thus there is very little requirement for direct human supervision except for set up, maintenance, and emergency needs.

People who work in such automated systems are interdependent components, required primarily to respond when something goes wrong. They are no longer operating in an environment where important events are predictable. For economic reasons, unexpected difficulties need to be corrected as quickly as possible, and this imposes certain requirements on those who are involved with the work. First, they must have a large repertoire of responses, since the specific things they could be called upon to do are not known in advance. Second, they cannot depend on supervision in the traditional sense, because they must respond immediately to events that occur without warning. And third, they must be committed to doing whatever is necessary on their own initiative.

This means that such organizations are far more dependent on individuals than has traditionally been the case. For, the organizations economic goals will not be met unless the production process functions properly. And this will not happen unless appropriate responses are taken to unexpected events. These appropriate responses will not be made unless people are committed to their functions. This commitment cannot be bought or forced, but can only arise as a result of people's experience in their working situation.

Result and Implications

Thus it would appear that significant social and technological forces are converging to promote work systems characterized by jobs that develop commitment. And it would seem appropriate for industries employing automated production systems to design or redesign organizations structured to develop such characteristics in their employees.

In these terms, a well designed job should have as many of the following characteristics as possible. It should:
(a) use an individual's skills and abilities
(b) provide opportunities for learning and development

(c) provide a defined area of responsibility, together with the opportunity to exercise discretion and make decisions

(d) provide an opportunity for social relations with colleagues

(e) make an identifiable contribution to the eventual product made, or the service provided

(f) be reasonably demanding, and present some degree of challenge

(g) provide for variety in the range of tasks performed

(h) be thought of as worth-while and meaningful by the person doing it

(i) lead to some sort of desirable future.

Reality

Yet, as Boguslaw[3] has noted:

> The new utopians (the computer systems designers) are concerned with nonpeople and with people substitutes. Their planning is done with computer hardware systems procedures, functional analysis and heuristics...the theoretical and practical solutions they seek call increasingly for decreases...in the scope of responsibility of human beings within the operating structures of their new machine systems.

Today, many system designers and managers appear to assume that organizations do not have to take human needs into account since appropriate rewards and punishments can be built in to secure acceptance as required. Therefore the organization that results from optimizing the technical requirements is seen as the proper choice.

Yet, systems designed in this way are not technologically determined. The complexity of the design task is often considerable, and the consequences and alternatives involved are difficult to evaluate. Values play an important part in guiding the designers choice between different alternatives. Organizations are invented by embedding technology into social systems through the allocation of tasks. Task-allocation decisions reflect values about desirable behavior, as well as being made for the purposes of the technology alone. Thus, systems are created in terms of a vision of man and his needs and abilities which is greatly influenced by the designers own values and experiences.

Most designers do not understand that a substantial part of technical system design involves social system design. They fail to recognize that the decision making process includes values as well as facts in its

decision base, and these affect the solutions which are perceived and selected.

Sociotechnical Systems

Over the past couple of decades, research in both Europe and the United States has been focussed on demonstrating that work organizations must be regarded not simply as technical systems or as social systems, but as joint sociotechnical systems. To achieve optimum performance from the organization as a whole, it is necessary to design both the social system and the technical system to fit the product being produced.

Selection of the technical system, then, should include consideration of its consequences on the lives and jobs of those who will operate and maintain it. Note that by 'technical system' I am not referring only to machines or hardware, but also to the processes by which the hardware is operated, namely the software. The resulting tasks should be assigned so as to leave as much detail as possible unspecified. This then transfers discretion for coordination and control to people in the workplace, compatible with the vital needs of the system (which frequently turn out to be far less than designers presently believe).

Sociotechnical analysis provides a basis to determine the appropriate organizational boundaries for systems containing men, machines, materials and information. It analyzes the variability of the technical processes to see what type of human reaction is required, if together they are to produce certain end results. These requirements can then be translated into guidelines for assigning tasks to teams, or where necessary to individuals, and a work system can be created which optimizes conflicting requirements rather than maximizing any one separately. Thus jobs can be invented to build and maintain a positive interdependence between individual needs and organizational goals. This recognizes that involvement at every level of decision making is important and that each is complementary, rather than a substitute for any of the others.

The sociotechnical approach emphasizes feedback and training, so that information can be easily accessible to and understood by the majority of the people. Designers in automated systems should strive to demystify the technology as much as possible, since computer literacy is essential for informed human choice, and people will not trust what they do not

understand. It is important that the organizational reality created by
the work system designer coincides with the reality of those who work in
the system. Indeed, any organization which does not put to use the knowledge,
resources, experience and imagination of the people who make it function is
unlikely to be effective for very long. So, people and machines are viewed
as essentially complementary rather than as being comparable, and tasks
are allocated between them on that basis. Nothing could be more inefficient
or self-defeating in the long run than the construction of a man-machine
system which causes the people involved to rebel against it.

The sociotechnical approach stresses that an organization's social and
technical systems must be jointly considered together with their relation-
ship to the external environment. It represents a movement away from a
limited concern with job satisfaction of the individual, to a more compre-
hensive approach aimed at the design and functioning of the organization
as a whole. Recent applications have involved the establishment of self
regulating work groups around a whole identifiable part of a work process.
The group members then arrange among themselves how the work is to be shared
and organized, agree on targets for production with management and are some-
times concerned with the selection and training of new employees.

Group working may systematically include such approaches as job en-
largement, enrichment, rotation or flexible working hours in order to improve
opportunities for autonomy, variety and task identity. However, the oppor-
tunities provided by semiautonomous work groups for more meaningful work
for individuals and enhancing organizational effectiveness would appear to
be far greater than with any of the above job-modification techniques.

Conclusion

For too long we have been looking at work system design from the stand
point of optimizing technological and economic efficiency - how to reduce
idle periods, analyze two-handed operations, and balance production lines
to minimize overall cycle time - with motivation to work being regarded as
a separate and constraining issue. The jobs that resulted from such approaches,
together with the technology involved, were accepted as facts of life. Empha-
sis was placed on adapting people to fixed jobs and providing a social climate
where they felt at ease. More recently, it has become clear that these
blueprints for organizational design are not functioning satisfactorily in

actual practice. The message that emerges is that motivation must be embedded in the task, in the work itself. Technology today is rich enough in potential arrangements that design decisions can be made by jointly optimizing both the needs of the production process and those of the people who work with it. The opportunities involved can only be fully realized by a process of innovation, trial and evaluation -- in other words, by action -- and now is the time to make a start.

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Biographical Sketch

John J. Cotter is the Program and Project Development Officer for the Center for Quality of Working Life in the Institute of Industrial Relations at the University of California, Los Angeles. He was formerly Executive Vice President and General Manager for the Los Angeles based Microwave Component Division of the Sterling Electronics Corporation, Houston, Texas. Prior to that he was Vice President, Operations, E and M Laboratories, North Hollywood, California; Program Manager, Huggins Laboratories, Sunnyvale, California; and Research Physicist, Mullard Equipment Limited, Sussex, England. Mr. Cotter holds several patents in the field of Microwave Component Technology. He has had sixteen years of diverse international experience at all levels of management in primarily high technology industries.

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