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# The evolution of socio-technical systems

## a conceptual framework and an action research program

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# Foreword

## About the author

Eric Trist is uniquely qualified to write this review of the evolution of the socio-technical concept. The following paper represents a scanning of both the chief theoretical underpinnings of the concept and its practical development in the field, which parallels and, in some instances, coincides with the development of the thinking and practice of Trist and his colleagues.

Eric Trist's career, which spans almost five decades, has advanced the state of the art of QWL both conceptually and in application. He has been involved in 'action research' with many organizations beginning with his pioneering work in the British coal mining industry in the early 1950's – work which laid the foundations for the field now known as the 'quality of working life'.

He is currently an Associate of the Ontario Quality of Working Life Centre, Professor of Organizational Behaviour and Social Ecology at the Faculty of Environmental Studies, York University, and Professor Emeritus and Chairman of the Management and Behavioural Science Centre, Wharton School, University of Pennsylvania. At Wharton, he recently completed a two-year study of labour management cooperation and work innovation in the public sector in ten American cities.

Eric Trist was a founding member, and later chairman, of the Tavistock Institute of Human Relations in London. He worked with the Tavistock for twenty years during a time when some of the major advances in the socio-technical field were being made. In 1966 he went to the School of Management at UCLA where, with Louis E. Davis, he developed the first graduate program in socio-technical systems in a university. In 1969 he moved to the University of Pennsylvania to work with Russell Ackoff in creating a new interdisciplinary doctoral degree in Social Systems Studies.

## About this paper

This paper consists of a first-ever overview of the evolution of socio-technical systems from its original formulation in the early Tavistock mining studies until the present.

Socio-technical analysis is made at three levels – the primary work system; the whole organization; and macrosocial phenomena. Trist examines the relations between these levels in the historical context which influenced both the type and scope of the projects which were feasible.

Section One of the paper traces the development of concepts and action research between 1950 and 1970 – a period which until now has not been fully understood or described.

Section Two focuses on the theme of socio-technical studies at the level of the primary work system. It outlines the principles or work design and analysis, and describes the structures of autonomous work groups, matrices and networks – the new building blocks for organizational design.

Section Three is concerned with the implications of socio-technical studies for the organization as a whole in relation to its changing environment. The difficulties experienced in transforming established organizations are discussed and a change strategy is outlined.

Section Four is a look at the future from a macrosocial perspective, with the central issue of the microprocessor revolution and its implications for the meaning of work.

Trist concludes his paper with some lessons from past experience and some directions for the future which may serve to stabilize and sustain QWL developments currently in the embryonic stages, and to aid in the process of diffusion. He suggests that 'the study of networks, processes which are fluid and unbounded, seems to offer one of the most promising ways of increasing our understanding of the diffusion, process.' In his own words:

> 'Now that the salient environment is becoming that of a turbulent field, a greater emphasis on collaboration is mandatory, and relevant changes need to be fostered in large-scale social systems as well as within organizations.'

# 1 The historical background
(1950–1970)

## Origin of the concept

The socio-technical concept arose in conjunction with the first of several field projects undertaken by the Tavistock Institute in the British coal mining industry. The time (1949) was that of the postwar reconstruction of industry in relation to which the Institute had two action research projects.* One was concerned with group relations in depth at all levels (including the management/labor interface) in a single organization – an engineering company in the private sector. The other project focused on the diffusion of innovative work practices and organizational arrangements which did not require major capital expenditure but which gave promise of raising productivity. The former project represented the first comprehensive application in an industrial setting of the socio-clinical ideas concerning groups being developed at the Tavistock. For this purpose a novel action research methodology was introduced. The book describing the project became a classic (*Jaques,* 1951). Nevertheless, it approached the organization exclusively as a social system. The second project was led, through the circumstances to be described below, to include the technical as well as the social system in the factors to be considered and to postulate that the relations between them should constitute *a new field of inquiry*.

Coal being then the chief source of power, a lot depended in industrial reconstruction on there being a plentiful and cheap supply of it. But the newly nationalized industry was not doing well. Productivity failed to increase in step with increases in mechanization. Men were leaving the mines in large numbers for more attractive opportunities in the factory world. Among those who remained, absenteeism averaged 20%. Labour disputes were frequent despite improved conditions of employment. Some time earlier the National Coal Board had asked the Institute to make a comparative study of a high producing, high morale mine and a low producing, low morale but otherwise equivalent mine. Despite nationalization, however, our research team was not welcome at the coal face under the auspices of the Board.

*Through the Human Factors Panel of the then government's Productivity Committee on funds administered by the Medical Research Council.

There were at the Institute at that time six postgraduate Fellows being trained for industrial field work. Among these, three had a trade union background and one, the late Ken Bamforth, had been a miner. After a year, the Fellows were encouraged to revisit their former industries and make a report on any new perceptions they might have. Bamforth returned with news of an innovation in work practice and organization which had occurred in a new seam in the colliery where he used to work in the South Yorkshire coalfield. The seam, the Haighmoor, had become possible to mine 'shortwall' because of improved roof control. I can recall now the excitement with which I listened to him. No time was lost in my going up to visit this colliery where, since we were introduced by him, the local management and union readily agreed to our 'researching' their innovation with a view to its diffusion to other mines. The area general manager (who had the oversight of some 20 mines) welcomed the idea. The technical conception of the new scheme was his, though the men, with union support, had proposed the manning arrangements.

The work organization of the new seam was, to us, a novel phenomenon consisting of a set of relatively autonomous groups interchanging roles and shifts and regulating their affairs with a minimum of supervision. Cooperation between task groups was everywhere in evidence; personal commitment was obvious, absenteeism low, accidents infrequent, productivity high. The contrast was large between the atmosphere and arrangements on these faces and those in the conventional areas of the pit, where the negative features characteristic of the industry were glaringly apparent. The men told us that in order to adapt with best advantage to the technical conditions in the new seam, they had evolved a form of work organization based on practices common in unmechanized days when small groups, who took responsibility for the entire cycle, had worked autonomously. These practices had disappeared as the pits became progressively more mechanized in relation to the introduction of 'longwall' working. This had enlarged the scale of operations and led to aggregates of men of considerable size having their jobs broken down into one-man-one-task roles, while coordination and control had been externalized in supervision, which had become coercive. Now they had found a way at a higher level of mechanization of recovering the group cohesion and self-regulation they had lost and of advancing their power to participate in decisions concerning their work arrangements. For this reason, the book which overviewed the Tavistock mining studies was subtitled, 'The Loss, Rediscovery and Transformation of a Work Tradition.' (*Trist* et al., 1963). The transformation represented a change of direction in organizational design. For several decades the prevailing direction had been to increase bureaucratization with each increase in scale and level of mechanization. The organizational model that fused

Weber's description of bureaucracy with Frederick Taylor's concept of scientific management had become pervasive. The Haighmoor innovation showed that there was an alternative.

Those concerned with it had made an *organizational choice (Trist* et al., 1963). They could, with minor modifications, have extended the prevailing mode of working. They chose instead to elaborate a major design alternative. It was not true that the only way of designing work organizations must conform to Tayloristic and bureaucratic principles. There were other ways, which represented a discontinuity with the prevailing mode. The technological imperative could be disobeyed with positive economic as well as human results. As became clearer later, what happened in the Haighmoor seam gave to Bamforth and myself a first glimpse of 'the emergence of a new paradigm of work' (*Emery,* 1978a) in which the best match would be sought between the requirements of the social and technical systems.

Some of the principles involved were as follows:

1) The *work system,* which comprised a set of activities that made up a functioning whole, now became the basic unit rather than the single jobs into which it was decomposable.

2) Correspondingly, the *work group* became central rather than the individual job-holder.

3) *Internal regulation* of the system by the group was thus rendered possible rather than the external regulation of individuals by supervisors.

4) A design principle based on the *redundancy of functions** rather than the redundancy of parts (*Emery,* 1967) characterized the underlying organizational philosophy which tended to develop multiple skills in the individual and immensely increase the response repertoire of the group.

5) This principle valued the *discretionary* rather than the prescribed part of work roles (*Jaques,* 1956).

6) It treated the individual as *complementary* to the machine rather than as an extension of it (*Jordan,* 1963).

7) It was *variety-increasing* for both the individual and the organization rather than variety decreasing in the bureaucratic mode.

*This is explained on page 17.

Conceptually, the new paradigm entailed a shift in the way work organizations were envisaged. Engineers, following the technological imperative, would design whatever organization the technology seemed to require. This was a rule accepted by all concerned (*Davis* et al., 1955). The 'people cost' of proceeding in this way was not considered. Any people cost, it was presumed, could be compensated for first by improving the socioeconomic conditions or employment, next by improving 'human relations'. The movement under this latter title arose during the interwar period when the model of the technocratic bureaucracy was becoming entrenched. It failed to arrest the spread of work alienation after World War II (*Baldamus*, 1951, 1961; *Walker and Guest*, 1952). At the Glacier Metal Company where Jaques (1951) carried out his research, it was observed that, despite the progressive personnel policies adopted and the far-reaching changes made in the character of management-labor relations, there was no reduction in 'the split at the bottom of the executive chain.' Nothing had happened to change the structure of jobs. There was no change in the nature of immediate work experience.

The idea of separate approaches to the social and the technical systems of an organization could no longer suffice for one such as myself who had experienced the profound consequences of a change in social-technical relations such as had occurred in the Haighmoor development. Work organizations exist to do work – which involves people using technological artifacts (whether hard or soft) to carry out sets of tasks related to specified overall purposes. Accordingly, a conceptual reframing was proposed in which work organizations were envisaged as socio-technical systems rather than simply as social systems (*Trist*, 1950a). The social and technical systems were the substantive factors – the people and the equipment. Economic performance and job satisfaction were outcomes, the level of which depended on the goodness of fit between the substantive factors. The following research tasks emerged in the Tavistock program:

1) The theoretical development of the core concept.

2) Methods for the analytical study of the relations of technologies and organizational forms in different settings.

3) A search for criteria to obtain the best match between the technological and social components.

4) Action research to improve the match.

5) Ways to measure and evaluate outcomes through comparative and longitudinal studies.

6) Ways to diffuse socio-technical improvements.

These tasks could not be carried out in a preplanned sequence. The research team had first to make an extensive reconnaissance of the field to locate relevant opportunities. It then had to become actively linked to them in ways which would sanction their study in a collaborative mode. The idiom of inquiry was action research (*Trist*, 1976b).

Socio-technical studies needed to be carried out at three broad levels – from micro to macro – each of which is interrelated.

1) *Primary work systems*. These are the systems which carry out the set of activities involved in an identifiable and bounded subsystem of a whole organization – such as a line department or service unit (c.f. *Miller*, 1959). They may consist of a single face-to-face group or a number of such groups together with support and specialist personnel and representatives of management plus the relevant equipment and other resources. They have a recognized purpose which unifies the people and the activities.

2) *Whole organization systems*. At one limit these would be plants or equivalent self-standing workplaces. At the other they would be entire corporations or public agencies. They persist by maintaining a steady state with their environment.

3) *Macrosocial systems*. These include systems in communities and industrial sectors and institutions operating at the overall level of a society. They constitute what I have called 'domains' (*Trist*, 1976a, 1979a). One may regard media as socio-technical systems. McLuhan (1964) has shown that the technical character of different media has far-reaching effects on users. The same applies to architectural forms and the infrastructure of the built-environment. Although these are not organizations, they are socio-technical phenomena. They are media in Heider's (1942) as well as McLuhan's sense.

As the historical process of a society unfolds individuals change their values and expectations concerning work roles. This changes the parameters of organizational design. Conversely, changes in technology bring about changes in values, cognitive structures, life-styles, habitats and communications which profoundly alter a society and its chances of survival. Socio-technical phenomena are contextual as well as organizational.

Not all social systems are socio-technical. Emery (1959), following Nadel (1951), distinguished between 'operative' and 'regulative' institutions and proposed to restrict the term 'socio-technical' to the former. Regulative organizations are concerned directly with the psychosocial ends of their members and with instilling, maintaining or changing cultural values and norms, the power and the position

of interest groups, or the social structure itself. Many such organizations employ technologies as adjuncts and have secondary instrumental systems which are socio-technical. By contrast, organizations which are primarily socio-technical are directly dependent on their material means and resources for their outputs. Their core interface consists of the relations between a nonhuman system and a human system.

There are mixed forms typified by the co-presence of psychosocial and socio-technical ends which may be congruent or conflicting. An example of the latter would be a prison with both an electronic surveillance system and a therapeutic community. Hospitals are inherently socio-technical as well as psychosocial, which accounts for the complexity of some of their dilemmas.

From the beginning the socio-technical concept has developed in terms of systems, since it is concerned with interdependencies. It has also developed in terms of open system theory, since it is concerned with the environment in which an organization has actively to maintain a steady state. Von Bertalanffy's (1950) paper on '*Open Systems in Physics and Biology*' became available at the time that the socio-technical concept was being formulated. It influenced both theory building and field projects, compelling attention alike to self-regulation and environmental relations. As regards the special role of technology, Emery (1959) put it as follows:

> the *technological component,* in converting inputs into outputs, *plays a major role in determining the self-regulating properties of an enterprise.* It functions as one of the major boundary conditions of the social system in mediating between the ends of an enterprise and the external environment. Because of this, the materials, machines and territory that go to making up the technological component are usually defined, in any modern society, as 'belonging' to an enterprise, or are excluded from similar control by other enterprises. They represent as it were, an 'internal environment'. This being the case, it is not possible to define the conditions under which such an open system achieves a steady state unless the mediating boundary conditions are in some way represented amongst 'the system constants' (cf. *Von Bertalanffy,* 1950). The technological component has been found to play this mediating role and hence it follows that the open system concept, as applied to the enterprise, ought to be referred to the socio-technical system, not simply to the social system.

## Source influences

An interest in social and technical relations arose in my own thinking first at the macrosocial level, next at the whole organization level and thence at the level of primary work systems. This last, however, became the crucial level as regards the initiation of field projects which provided the concrete route through which the broader levels could again be reached.

Mumford (1934) in '*Technics and Civilizations*' had introduced me to the idea of linking the two. Anthropology and cultural history

suggested that, if the material and symbolic cultures of a society were not connected by any simple principle of linear causality (as some interpreters of Marx have implied), they were nevertheless intertwined in a complex web of mutual causality (*Trist,* 1950b). In the language of E.A. Singer (1959) they were co-producers of each other. The technological choices made by a society are critical expressions of its world view. As new technologies develop, new societal possibilities may or may not be taken up. The mode of their elaboration may be constructive or destructive. There are unanticipated consequences. In the period following World War II the information technologies of the second industrial revolution were already beginning to make themselves felt. It seemed not unlikely that there would be as big a cultural shift associated with them as with the energy technologies of the first industrial revolution.

As regards the whole organization level, the first industrial project in which I was involved made it impossible not to look at the relations between technical and social systems. This encounter was with the jute industry in Dundee, Scotland, where in the late thirties I was a member of an interdisciplinary research team studying unemployment. The spinning section of the industry was being 'rationalized', causing not only more unemployment but a de-skilling of the remaining workers, along with an extension of managerial controls. As to alienation, workers in the interview sample would say that they might as well be unemployed, while the appearance of time-study men provoked a bitter reaction in the trade unions. In the changes taking place, the technical and social aspects were interactive. A new socio-technical system emerged – that of a more controlling 'technocratic bureaucracy' with very different properties from the earlier system in terms of which jute spinning had been, and jute weaving still was, organized. Then came World War II. A new military socio-technical system appeared in the form of the German Panzer Divisions, formidably competent in the way they linked men and machines to fit their purposes. The French army had failed to develop an equivalent, despite de Gaulle's proposals.

As the war proceeded, military technology gave increasing scope for, and prominence to, small group formations, recognizing their power to make flexible decisions and to remain cohesive under rapidly changing conditions. This led to a recasting of the role of junior officers and the kind of relations (more open and more democratic) best maintained between them and their men. In Britain the War Office Selection Boards (to which I was attached) were created to choose officers capable of behaving in this way. The Boards made extensive use of W.R. Bion's (1946) method of leaderless groups, which allowed leadership to emerge and rotate in a variety of group settings. All this opened up new areas of group dynamics – extended after the war when Bion (1950, 1961) introduced therapy groups at the Tavistock Clinic. A parallel influence was that of Lewin's (1939, 1951) experiments on group climates and group

decision making, together with the beginnings of the National Training Laboratories. These traditions became fused at the Tavistock. Bion focussed on the unconscious factors obstructing the attainment of group purposes and on group creativeness; Lewin on the commitment to action consequent on participation and on the performance superiority of the democratic mode. Both emphasized the capacity of the small group for self-regulation, an aspect of systems theory which received increasing attention as cybernetics developed (*Weiner*, 1950).

## Going against the grain of the fifties

To a number of us at this time, and certainly to me, it seemed that the small self-regulating group held the clue to a very great deal that might be improved in work organizations. Knowledge about it had made considerable advances during and immediately after World War II. Yet experiences in industry in the reconstruction period had shown that socio-technical relations were patterned on the breakdown of work into externally controlled one-man-one-job units and that top-down management hierarchies were being even more rigidly maintained than in the prewar period. The pattern of technocratic bureaucracy was increasing in strength.

Hence the interest of the Haighmoor development, which pointed to the existence of an alternative pattern going in the opposite direction to the prevailing mode. The Divisional Board, however, did not wish attention drawn to it. They feared the power change that would be consequent on allowing groups to become more autonomous at a time when they themselves were intent on intensifying managerial controls in order to accelerate the full mechanization of the mines. They refused to allow the research to continue and balked at Bamforth and myself referring to it in the paper that we published (1951) on conventional longwall working. It would lead, they said, to expectations that could not be fulfilled; for, while autonomous groups might be successful on the Haighmoor shortwalls, they would not be feasible on longwall layouts which represented the prevailing method of mining. Later, this opinion was found to be false, though widely believed. The Divisional Board's reaction suggested that any attempt to reverse the prevailing mode would be met with very serious resistance. To move in the opposite direction meant going against the grain of a macrosocial trend of institution-building in terms of the model of the technocratic bureaucracy, which had yet to reach its peak or disclose its dysfunctionality.

Several major pioneer studies were carried out during the decade. They established a number of research findings of key importance. Their effect on industrial practice was negligible. Neither what happened nor what failed to happen is widely known. These studies are reviewed here to provide a short account of what turned out to be the latency decade of the socio-technical approach.

## The continuation of the mining studies

If the Haighmoor development had general meaning, it was reasonable to assume that similar developments would occur elsewhere. In fact, a parallel development in a more advanced form and on a larger scale emerged in another Division of the National Coal Board (East Midlands), where one of the Area Managers, W.V. Sheppard (1949, 1951), was developing a method of continuous mining – a radical innovation designed on what appeared to be socio-technical principles. There were two versions: the semi-mechanized (*Wilson and Trist,* 1951) and the fully mechanized (*Trist,* 1953a). The second was delayed because of teething troubles in an ingenious but somewhat underpowered cutter-loader invented by Sheppard. Faces were 100 yards in length, alternating advance with retreat and concentrated in one district so that only one main road needed to be maintained. Autonomous groups of 20-25 conducted all operations on one shift. There were three production shifts every 24 hours instead of one – the other two shifts had been concerned with coal face preparation and equipment shifting which were now done in parallel with coal getting. All members were multi-skilled and were paid the same day wage, which was judged more appropriate for continuous mining than a bonus. Productivity and work satisfaction were unusually and consistently high. A beginning was made in spreading the new system to six pits. Emery (1952), who was over at the Tavistock on sabbatical from Australia, made a study of this process, paying special attention to required changes in the supervisor's role. After area-wide appreciation conferences had been held for managers and under-managers, an Area Training School was designed (*Trist,* 1953b) to which groups of eight (operators, foremen and mechanics) from each pit scheduled to go over to the new system came for a week (during which they visited the original mine). Members of these groups began to meet weekly to compare experiences. A kind of socio-technical development center was created. This model was not picked up again for another twelve years, when something like it emerged both in the Norwegian Industrial Democracy project (*Emery and Thorsrud,* 1976) and the Shell Philosophy project (*Hill,* 1971). It was a forerunner of 'the deep slice' used by Emery (1976) in his method of Participant Design.

A study of overall area organization was made (*Trist,* 1953c). The incoming technology in association with autonomous work groups reduced by one the number of management levels underground. Group Centers between collieries and the Area Office were obviously redundant. Divisional Boards between operating Areas and the National Headquarters in London also seemed unnecessary. These superfluous levels of management were based on narrow spans of control which implied detailed supervision of subordinates at all levels rather than the socio-technical concept of boundary management which was congruent with maximizing the degree of self-regulation throughout an entire organizational system. In the course of time, these levels were in fact eliminated. This showed how the socio-

technical concept could affect the organization as a whole and reduce the administrative overhead which has become so excessive in large technocratic and bureaucratic organizations.

Having reached the whole organization system level, our research efforts (though on independent funds) were again stopped when a new Divisional Chairman took over. What had happened was seen in an entirely technological perspective – that of the new cutter-loader which had been introduced. Since this was judged not as good a bet for further mechanization as another similar machine, the whole project was regarded as not meriting continuation. Besides, granting more autonomy was not popular. The union regionally negotiated special pay for operators of new equipment. This broke up the unity of the face groups, which were further decimated when bonuses were introduced for various classes of workers. Within a year or two, the conventional system reinstated itself.

Sociologically, this setback and the earlier one over the Haighmoor may be seen as examples of what Schon (1971) has called the 'dynamic conservatism' of organizations. Psychologically, at the unconscious level, these setbacks may be seen as stemming from 'envious attacks' on the innovations and the innovators. In psycho-analytic object relations theory (*Klein*, 1958) a good object, which one cannot bear because it is not one's own, may for that reason be turned into something bad, which then becomes a threat through having one's hostility projected on to it. Creativeness is apt to stir up jealous hatred of this kind and the creators all too often become the targets of destructive spite. I have encountered a number of cases of this in studies of innovation with which I have been associated.

A search of other coalfields produced only one, Durham, where the Divisional Board and the regional organization of the National Union of Mineworkers said they would like to proceed with social research into mining methods. Virtually all extant methods were available in the same low seam in a single area in the older part of the coalfield where customs were uniform and traditions common. Here, the research team found what the conventional wisdom had held to be impossible: the working of the conventional, semimech-anized, three-shift longwall cycle by a set of autonomous work groups (locally known as composite). Groups of 40-50 men inter-changed the various jobs required while alternating shifts in ways they felt best and evolving an innovative pay system that seemed equita-ble to them. Output was 25 percent higher with lower costs than on a comparison face similar in every respect (conditions, equipment, personnel) except that of work organization. Accidents, sickness and absenteeism were cut in half (*Trist* et al, 1963). Only one man left the composite faces in two years. Over the four-year period of the project, the conversion of an entire colliery with three seams from conventional to composite working was followed in detail. Much was learned about the conditions under which autonomous

groups prosper and under which they fail. The potential of self-regulating groups in fully mechanized installations was studied and the research team began to collaborate in the design of socio-technical systems for the most advanced technology then available. A meticulous study of a single face team was made by Herbst (1962); it explored the mathematical relations between a number of key variables.

A report was submitted to the National Coal Board (*Trist and Murray*, 1958). The results were not disputed. But the Board's priorities were elsewhere – on the closing of uneconomic pits in the older coalfields and carrying the union with it in implementing the National Power-Loading agreement, deemed critical for full mechanization. It was not willing to encourage anything new that might disturb the delicately balanced situation as the industry contracted in face of the greater use of oil. On the union side, the Durham Miners' Association sent the report to the National Executive. No reply was received at the Tavistock Institute.

Dr. Hugh Murray has since* made an archival study of composite agreements in the various British coalfields. There were quite a few of these in the mid-fifties, but they were regarded simply as wage settlements. There was no understanding that they might have implications for work-organization.

In the late sixties Murray carried out an action-research study of layouts using very advanced technology. He found that the coincidence of specialized work roles and high absentee rates was giving rise to wide-scale disruption of production processes. Men were posted to places in their speciality all over the mine through a 'pit market.' There was little cohesion in work teams. Efforts to introduce multi-skilling, which would have afforded the basis for greater team cohesion, met with little success (*Murray* et al., 1969).

During the seventies an experimental section based on autonomous groups was tried out in a mine in the American coal industry with its room-and-pillar layouts and very different technology of roof bolting, continuous miners and shuttle cars. Positive results were obtained comparable to those obtained earlier in Britain; not only as regards productivity but as regards safety, which was the reason for union collaboration. Although a second autonomous section was started, an attempt to diffuse this form of work organization to the mine as a whole encountered insuperable difficulties which were not foreseen by members of the Labor-Management Steering Committee or the research team (*Trist, Brown and Susman*, 1979). This project has been independently evaluated by Goodman (1979).

*Personal communication, 1977.

The difficulties centred on the resentment of those not included in the experiment towards the privileges of those who were. This resentment would not have become acute had not expansion of the mine led to some inexperienced new recruits winning places on the second autonomous section (and hence the top rate) when experienced men withdrew their bids at the last moment in order to stay with a foreman (who then deserted them). There was no infringement of seniority rules, but the issue split the union.

The project shows in great detail how unanticipated and uncontrollable events in the broader as well as the immediate context can influence outcome in the later stages of an action research undertaking. It also shows how the encapsulation of an innovation can prevent its diffusion and the dangers of applying classical experimental research design in the 'moving ground' of a real life field situation – even though this was a condition of receiving initial support at the mine and from the sponsors of the national program of which it was a part.

## Studies in other industries

Meanwhile, at the Tavistock, opportunities were sought in other industries. The first to arise was not only in another industry, textiles, but in another culture – India. In 1953 the late A.K. Rice (1958, 1963) paid his first visit to the Calico Mills in Ahmedabad in which an automatic loomshed was converted from conventional to autonomous group working, with results that surpassed expectations. Later, the change was diffused throughout the non-automatic weaving sheds in this very large organization, which employed 9,000 people. Rice did no more than mention through an interpreter the idea of a group of workers becoming responsible for a group of looms. The loomshed employees took up the idea themselves, coming back next day with a scheme which they asked management's permission to implement. Terms regarding a progressive payment scheme were negotiated, and the first trials of the new system began. As with the mines, major initiatives were taken by the workers themselves. The depth of their commitment became apparent later, when the Communist Party of India (orthodox) took offense at the 'Ahmedabad Experiment' and drafted a number of their members from various parts of the country into the city, swollen with refugees from West Pakistan, to agitate against it. Though their families were threatened and attempts were made to set Hindu and Muslim workers against each other, the Calico's employees stood by an innovation which was largely their own creation.

Yet the group method, as it was called, did not spread to other mills as originally expected. I asked Shankalal Banker, the venerable leader of the Ahmedabad Textiles Union, about this when I was in Ahmedabad in 1976. He replied that the other owners did not want to share the power. Also, as Miller (1975) reports, the non-automatic

loomsheds gradually regressed to conventional ways of working. Training was not kept up. New middle managers took over who knew little of what had originally taken place. Senior management became preoccupied with marketing and diversification. The automatic loomsheds, however, have retained the group method and their high level of performance and satisfaction with it.

During the early fifties also, Seymour Melman (1958), who had come over from Columbia to Oxford, made an in-depth study of work practices in the Standard Motor Company at Coventry. This company, which made both tractors and automobiles (and some airplane engines), employed 12,000 workers who, through their unions, largely controlled work arrangements and practices on the shop floor. There were only 70 foremen in the entire organization. Only 16 people were in the personnel department. There were only 8 time-study men. The ratio of administrative to production workers was far lower than in the rest of the industry and had been held steady while it increased elsewhere. At the automobile plant, the workers formed themselves into 15 large, internally differentiated groups varying from 50 to 500, each of which comprised a worker constituency which negotiated its detailed conditions of work and operating rules within a plant-wide union agreement, itself separate from the rest of the industry. The large groups were known as 'gangs'. They controlled upgrading and deployment among eight broad classes of jobs (reduced to these few from a very large number). They negotiated the bonus for the number of products turned out in a given time. These products constituted a major subsystem of the automobile. The bonus was large and induced component groups in the gangs to cooperate. The primary work systems, which contained many component groups, represented a sophisticated adaptation of earlier gang systems (which were disappearing) and constituted a complementary decision system to that of management. The foremen controlled the boundaries of productive activities, not the people.

The company increased its market share during the five years in question beyond that of other automobile companies in Britain, introduced automated equipment at a much earlier date, paid very much higher wages (yet had lower unit costs), remained attractively profitable and increased its assets by a third. In later years (the company was eventually taken over by British Leyland) this pattern of work organization met with severe management opposition. Too much power was being shared. Yet where the prevailing mode of a highly controlling technocratic bureaucracy has been imposed, there have been substantial increases in administrative costs and huge labor trouble.*

*Melman's work was not known to the Tavistock at the time, nor the Tavistock work to him. An account of subsequent developments in shop floor control in the automobile and other industries is given in Coates and Topham (1980), *'Workers' Control and Self-Management in Great Britain.'*

The Tavistock workers sought to discover how far alternative organizational patterns existed in service industries. An instance was found in a large national retail chain consisting of small shops run by 4-6 employees with shared tasks and all-around skills; the 'manager' was a working charge-hand. (*Pollock,* 1954). When, however, this organization enlarged its shops and extended its lines of sale, specialized jobs with several different statuses and rewards appeared along with formal control mechanisms.

At roughly the same time, opportunity arose to explore the possibility of an alternative organizational mode in a large teaching hospital. Advances in medical technology had turned the hospital into 'high pressure' center for intensive treatment while reducing the length of patient stay and extending the range of diseases coped with. This had created quite severe problems in nurse training. The work system consisted of a set of tasks broken down into narrow jobs in a closely similar way to that in large-scale industry. An attempt to introduce, in an experimental ward, the concept of a group of nurses becoming responsible for a group of patients met with both medical and administrative resistance, though much was learned about the embodiment in social structure and professional culture of psychological defenses against anxiety (*Menzies,* 1960). Integrated ward teams have since been developed in Australia by Stoelwinder (1978; *Stoelwinder and Clayton,* 1978).

As the last years of the postwar period came to a close in the early-fifties, the mood of the society changed from collaboration, which had fostered local innovation, to competition and an adversarial climate in management-labor relations, which discouraged it. No further instances of an alternative pattern were identified. Nevertheless, the mining, textile, and automotive studies had suggested that continuous production industries which were advancing in automation might develop requirements which could eventually lead in a direction counter to the prevailing mode. Accordingly, analytic socio-technical studies were instituted in chemical plants and power stations (*Murray,* 1960; *Emery and Marek,* 1962). These studies disclosed a basic change in the core shop-floor tasks: the worker was now outside the technology, adjusting, interpreting, monitoring, etc; he had become a manager of a work system; he needed conceptual and perceptual skills rather than manipulative and physical skills. He usually worked interdependently with others because his essential task was to keep a complex system in a steady state. The opportunity to go over to an alternative pattern, however, did not seem to be under any 'hot pursuit', though Bell (1956) had pointed to the possibility and Woodward (1958) noted the presence of fewer supervisors in continuous process than in mass production plants.

For a moment it looked as though a major action research opportunity would be forthcoming in Britain. Richard Thomas and Baldwin

(RTB), the largest complex in the British Steel industry, were preparing to build the most modern steelworks in Europe. They wanted to break with many constraining precedents in management and work practices that would inhibit full advantage being taken of the most advanced equipment. The Director of Education and Training invited the Tavistock to collaborate with him in evolving a new set of roles and decision rules, indeed a whole organizational structure, that would be a better match to the new technology. The method proposed was a series of participative workshops to be held in the RTB Staff College which would be attended by the different levels and functions of management, foremen, key operators and shop stewards. But there were delays in site construction – the ground proved more marshy than expected – and huge additional expenditures were incurred. The participative workshops were never held. In the end, an organizational structure and the various associated appointees were crash-programmed, and all the old roles and practices were reinstated with negative consequences (as time showed) of a severe kind (*Miller and Rice*, 1967).

There was a rising interest in socio-technical relations among a number of social scientists concerned with industry in the British setting. In Scotland, Burns and Stalker (1961) observed a new management pattern which they called 'organismic' as contrasted with 'mechanistic,' in more technologically advanced industry. Woodward (1958) related changes in organizational structure to broad types of technology. Fensham and Hooper (1964) showed the increasing mismatch between conventional management and the requirements of a rationalized rayon industry. Such studies, however, were widely interpreted (not necessarily by their authors) as supporting a theory of technological determinism. There could be no organizational choice, as had been suggested by the Tavistock researchers.

In the U.S., attention had been drawn to the counterproductive consequences of extreme job fractionization (*Walker and Guest*, 1952). But concepts of job enlargement and rotation and later of job enrichment (*Herzberg* et al., 1959), though concerned with socio-technical relations, focused on the individual job rather than the work system. In its orthodox form, job enrichment did not countenance participation but relied on experts brought in by management.

In Continental Europe there were occasional signs of a concern with alternative organizational modes. Westerlund (1952) reported the introduction of small groups on the Stockholm telephone exchange. Indeed, a similar transformation had been carried out in Glasgow by a telecommunications engineer (*Smith*, 1952). King (1964), from a training approach, had introduced groups with a good deal of scope for self-regulation in small textile firms in Norway. Van Beinum (1963) had completed his studies in the Dutch telecommunications industry. In the U.S., Davis (1957) introduced the concept of job design. This constituted a basic critique of industrial engineering

and opened the way for systems change which could involve groups and encourage participation. A working relationship between him and the Tavistock group was established.

An opportunity for stocktaking occurred at an International Conference on Workers' Participation in Management in Vienna (*Trist*, 1958). Interest centered on co-determination in Germany and the Yugoslav workers councils. The idea of involving workers directly in decisions about what should best be done at their own level seemed strange to those concerned with industrial democracy. Only marginal attention was paid to the idea that an alternative pattern of work organization to that prevailing might be on the horizon; in the end, however, it was not entirely ignored (*Clegg*, 1960).

Confusion regarding the forms and meaning of industrial democracy has persisted and has still not been entirely cleared up. Four different forms may be distinguished, all of which represent modes of participation and the sharing of power. They are:

1) *Interest group democracy*, i.e., collective bargaining, through which organized labor gains power to take an independent role vis-à-vis management.

2) *Representative democracy* whereby those at the lower levels of an organization influence policies decided at higher levels (workers on boards, works councils).

3) *Owner democracy*, as in employee-owned firms and cooperative establishments where there is participation in the equity.

4) *Work-linked democracy*, whereby the participation is secured of those directly involved in decisions about how work shall be done at their own level.

These four forms may be found independently or together, in consonance or contradiction and in different degrees in various contemporary industrial societies. The work-linked form has been the last to appear historically and is that with which socio-technical restructuring of work is associated (*Trist*, 1979c). Increasing congruency may be hypothesized among the four factors in the longer run. Table 1-1 summarizes their current relations in selected countries. Organizational democracy would be a *preferable* term to industrial democracy.

**Table 1-1**

Distribution of forms of industrial democracy in selected countries (1980) on a scale 0-4*

| | *Collective bargaining* | *Representative* | *Owner* | *Work-linked* |
|---|---|---|---|---|
| Norway | 4 | 3½ | 1½ | 2½ |
| Sweden | 4 | 3½ | 1½ | 2½ |
| Holland | 3 | 2 | 1 | 1½ |
| Australia | 2½ | 1 | 1 | 1½ |
| Germany | 2½ | 4 | −1 | −1 |
| France | 2½ | 1 | −1 | −1 |
| Britain | 4 | 0 | 1 | 0+ |
| U.S. | 2 | 0+ | 1 | 1 |
| Canada | 2½ | 0+ | 1½ | −1 |
| Yugoslavia | 0 | 4 | 4 | 0+ |

Norway and Sweden exemplify a congruent Scandinavian pattern which Holland and Australia approximate. The larger European countries show no consistency. The U.S. and Canada express a North American form. Yugoslavia is very different with no independent unions.

*The ratings are personal estimates of the author.

## Conceptual developments

A monograph by Emery (1959), who had returned to the Tavistock, put forward a first generalized model of the dimensions of social and technical systems, showing that, though they were multiple, they were not so numerous that analysis would become unmanageable. Eight were identified on the technical side, including level of mechanization/automation, unit operations, the temporo-spatial scale of the production process, etc.* On the social side, rigorous attention had to be paid to occupational roles and their structure, methods of payment, the supervisory relationship, the work culture, etc. – all of which belong to the 'socio' rather than the 'psyche' group (*Jennings,* 1947). The psyche group, concerned with interpersonal relations and Bion-type 'basic assumptions' regarding group behavior, however important, was not the starting point. Appropriate structural settings had to be created before desirable social climates and positive interpersonal relations would have the conditions in which to develop.

The original formulation of social and technical relations had been made in terms of obtaining the best match or 'goodness of fit' between the two. In conjunction with the Norwegian Industrial

*The others were the natural characteristics of the material, the degree of centrality of the various productive operations, the character of the maintenance and supply operations and that of the immediate physical work setting.

Democracy project, to be referred to in what follows, Emery reformulated the matching process (in terms of the more advanced systems theory that had become available) as the *joint optimization of the social and technical systems*. The technical and social systems are *independent* of each other in the sense that the former follows the laws of the natural sciences while the latter follows the laws of the human sciences and is a purposeful system. Yet they are *correlative* in that one requires the other for the *transformation* of an input into an output, which comprises the functional task of a work system. Their relationship represents a *coupling* of dissimilars which can only be jointly optimized. Attempts to optimize for either the technical or social system alone will result in the suboptimization of the socio-technical whole.

In the language of Sommerhoff (1950, 1969), a work system depends on the social and technical components becoming *directively correlated* to produce a given goal state. They are *co-producers* of the outcome (*Ackoff and Emery*, 1972). The distinctive characteristics of each must be respected else their *contradictions* will intrude and their *complementarities* will remain unrealized.

This logic was held to underlie job and organizational design. Failure to build it into the primary work system would prevent it from becoming a property of the organization as a whole.

The conceptual advances were 'directively correlated' with the involvement of the Tavistock research team in the action-research opportunities which occurred as the decade of the sixties unfolded. A further round of developments took place in 1965 (*Davis, Emery and Herbst*, 1965) which are incorporated in the next section. 'On Purposeful Systems' (*Ackoff and Emery*, 1972) has had far-reaching influence on subsequent work.

## The pathfinding role of the Norwegian Industrial Democracy project

The hypothesis was made that no further advances could be expected until changes occurred in 'the extended social field' of forces at the macro-social level. Any happening of this kind would change the opportunities for and meaning of the efforts at the primary work system and whole organization levels. While no one could foretell where and when this might occur, such a happening could be expected from the increasing impact of the new information-based technologies.

The science-based industries were 'the leading part' of the Western industrial system. They functioned as the principal change-generators and brought about many other changes, directly or indirectly (*Emery and Trist*, 1973). Western societies were beginning what is often referred to as the second industrial revolution.

The anticipated happening occurred in 1962 in Norway, where little modernization of industry had taken place in comparison with other Scandinavian countries. Economic growth had slowed down; the largest paper and pulp company went bankrupt; Norwegian firms were being taken over by multinationals. In many other respects this very small country began to feel that it had lost control of its own destiny. Its environment had become what Emery and I (1963) have called 'turbulent'.

A sudden demand for workers' control erupted in the left wing of the trade union movement. Neither the Confederation of Employers nor the Confederation of Trade Unions felt they understood what it was about. Having set up an Institute for Social Research at the Technical University of Norway, they asked it to conduct an inquiry into the matter. Given the political pressures, Einar Thorsrud, the Director, who had close contacts with the Tavistock, felt the inquiry would be better undertaken in association with a group outside Norway, which had accumulated relevant experience. Accordingly, he invited the Tavistock to collaborate. Very soon Emery and I became, with Thorsrud, part of a planning committee composed of representatives of the two Confederations. The task was to work out a jointly evolved research design. Involvement of the key stakeholders in each step was a basic principle of the design.

The first inquiry undertaken was into the role of the workers' directors, whose existence was mandated by law in both state-owned enterprises and those in which the state had some capital (former German capital given to Norway by the Allies after World War II). Various members of the board were interviewed, including the workers' directors, the principal members of management and of the trade union organization. It was found that, whether the workers' directors were outstanding performers or not, their presence, though valued as enhancing democratic control, had no effect on the feelings of alienation on the shop floor or on performance (*Emery and Thorsrud,* 1964, 1969). Accordingly, it was proposed that a complementary approach be tried – that of securing the direct participation of workers in decisions about what was done at their own level. These findings were widely discussed throughout the two Confederations and in the press. A consensus was reached that the mode of direct participation should be tried. The committee chose two sectors of industry which were not doing well and which were of strategic importance for the future of the economy (paper and pulp and metal working). Criteria were established in terms of which plants might be selected to conduct socio-technical field experiments which would serve as demonstration projects. Joint committees within these sectors then chose likely plants, which the research team visited to test their suitability and to secure local participation.

The research team made a study of the culture and history of Norwegian society. Industrialization had been late and more benign than in those European countries (or the U.S.) where industrialization had occurred earlier. Industrial relations were stable at the national level where the two Confederations accepted their complementarity. Norway had not passed through a period during which patterns of deference to authority had become entrenched. Traditions of egalitarianism were deep and had been more continuously maintained than in most western societies. The hypothesis was made that this configuration would be favorable for the development of direct participation in the work place. These favorable conditions were strengthened by the homogeneity of the society and by its small size. Members of key groups knew each other and overlapped. If they decided to move in a new direction, networks existed through which a wide support base could soon come into existence.

These contextual conditions permitted a series of four major socio-technical field experiments involving work restructuring not only to be launched but in three cases to be sustained (*Emery and Thorsrud*, 1969, 1976). Yet the hypothesis that widespread diffusion into Norwegian industry would occur from high profile field sites turned out to be wrong. They became encapsulated (*Herbst*, 1976). The diffusion took place in Sweden at the end of the decade – when the Norwegian results created great interest in the Employers and Trade Union Associations. Thorsrud was invited to visit. By 1973 between 500 and 1,000 work-improvement projects of various kinds, small and large, were going on in many different industries. A new generation of Swedes (better educated and more affluent) refused (by absenteeism and turnover) to do the dullest and most menial jobs. The importation of Southern Europeans created social problems. Something had to be done. Managers and unions took up the Norwegian approach and adapted it to their own purposes.

After that, shifts in the macrosocial field in Scandinavia recentered attention on the representation of workers on boards of management just when, in Germany, some interest appeared in direct participation. A number of laws have been passed in Norway and Sweden whose effects are still being assimilated. In both countries a third of the members of the boards have to be workers' representatives.

## The Shell Philosophy project

In Britain a large-scale socio-technical project began by the Tavistock with Shell (U.K.) in 1965 showed the need to develop a new management philosophy to establish values and principles which could be seen by all to guide work redesign, if commitment was to be secured not only from the various levels of management but also from the work force (*Hill*, 1971). This project led to a whole series of two-and-a-half day, off-site, residential conferences to discuss the original draft philosophy and to amend and ratify it.

These conferences involved all levels of the organization from the Board to the shop floor and the outside trade-union officials as well as the shop stewards in five refineries.

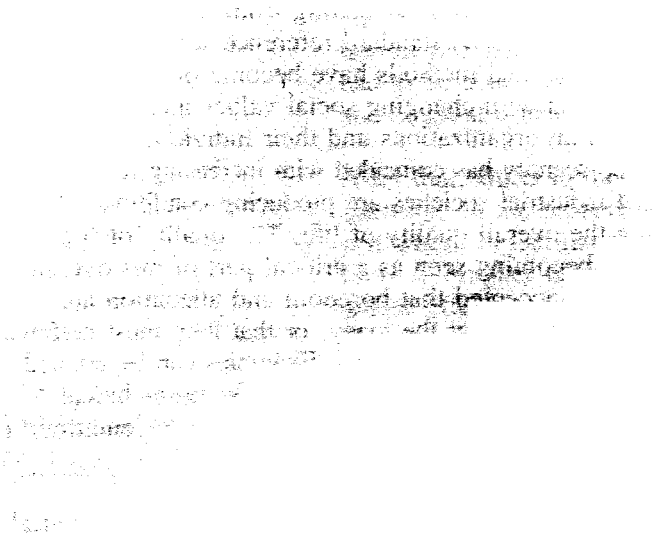
After some four years, the advances brought about by this project were arrested by an exceedingly complex situation within both the company and the industry. The ways in which the clock began to be turned back are described in Hill's (1971) book. The approach, however, was taken up by Shell in other countries – Australia, Holland, and more recently, Canada. It appears to be characteristic of innovative processes that after a certain time particular implementive sites reach their limit. The burden of trail-blazing is then taken up by others where favorable conditions emerge.

Meanwhile, what had happened regarding work restructuring and participation, especially in Sweden, created interest in the United States. Though one or two pioneer socio-technical projects had been under way for some time in the U.S., it was not until 1973 that wider public interest was awakened. Notions of work alienation were popularized by the media and associated with the threat of declining productivity in the face of Japanese and West German competition.

At an international conference held at Arden House in 1972, the term 'quality of working life' (QWL) was introduced by Dr. Louis Davis. Along with 'Work in America' (*O'Toole,*1972), which extended consideration to the mental health aspects of the workplace and the work-family interface, this conference has set the tone for further developments. In Bateson's (1972) sense, it repunctuated the field. The two volumes of papers emanating from it (*Davis and Cherns,* 1975) have become its standard reference work. Since then, socio-technical concepts and methods have become one input into a wider field concerned with changing social values and studying the effects of values on organizations and their individual members. The age of resource scarcity has coincided with increasing recognition that advanced industrial societies are producing conditions which are impoverishing the overall quality of life. The quality of life in the workplace is becoming seen as a critical part of this overall quality. It is now less accepted that boredom and alienation are inherently a part of work-life for the many, or that they must perforce accept authoritarian control in narrow jobs. Examples can be pointed to in almost any industry of alternative forms of socio-technical relations where these negative features do not have to be endured. For individuals and organizations alike, there is a choice.

In the fifties, the societal climate was negative toward socio-technical innovation. Thirty years later, as the eighties begin, the societal climate is becoming positive (*Walton,* 1979), though in most Western

countries the support base remains limited in face of the persisting power of the technocratic and bureaucratic mode. Yet this mode is being experienced as increasingly dysfunctional in the more complex and uncertain conditions of the wider environment. Emergent values are moving in the direction of regarding personal growth as a human right. All who wish it should have the opportunity to cultivate it. The work place constitutes a key setting for this purpose. A Norwegian law of 1976 gives workers the right to demand jobs conforming to the six psychological principles described in the next section of this paper. These are the principles which shaped the original socio-technical experiments of the Norwegian Industrial Democracy project.



# 2 Developments at the level of the primary work system

In reviewing the developments which have taken place since the socio-technical concept was established, it is appropriate to begin with the primary work system since this has been made the organizational building block.

The advent of the Norwegian Industrial Democracy project faced the research team with the task of intervening in the design of work systems. The situation was different from that of the fifties when the key innovations had appeared spontaneously. In the development of socio-technical studies, concepts and methods have evolved in relation to the demands of the field situation.

## The principles of work design

A set of principles was needed to improve work design so that the ideal of joint-optimization could be approached. Basic to this was some knowledge of the psychological requirements individuals have of their work beyond what is usually included in an employment contract. Herzberg et al. (1959) seemed to be right in separating the extrinsic from the intrinsic dimensions of job satisfaction, whatever the statistical arguments about 'dissatisfiers' and 'motivators'. What the trade unions had fought for had to remain or be won where it did not exist – adequate and fair pay, job security, benefits, safety, health, due process. These constituted the conditions of employment. What had also to be considered was how far jobs gave opportunities for an additional set of requirements that could only arise from the character of the jobs themselves and of the work organization in which they were embedded.

Drawing on Lewin's (1935) Berlin experiments on person-task relations (as well as on his and Bion's later work with groups), Emery (1964, 1976) identified six intrinsic characteristics (listed on the right of Table 2-1, which compares them with the extrinsic characteristics). The intrinsic characteristics may be spelled out as follows:

The need:

1) For the content of a job to be reasonably demanding in terms other than sheer endurance and to provide some variety (not necessarily novelty).

2) To be able to learn on the job and go on learning. Again it is a question of neither too much nor too little.

3) For an area of decision-making that the individual can call his own.

4) For a certain degree of social support and recognition in the work place for the value of what he does.

5) To be able to relate what he does and what he produces to his social life, for it to have meaning and to afford dignity.

6) To feel that the job leads to some sort of desirable future (not necessarily promotion).

These intrinsic requirements are not confined to any one level of employment. It is not possible to meet them in the same way in all work settings or for all kinds of people. They cannot always be judged from conscious expression. When there is no expectation that any of the jobs open to him will offer much chance of learning, a person will soon learn to 'forget' such a requirement.

The requirements are too general to serve as principles for work redesign. For this purpose they need to be linked to the objective characteristics of industrial jobs (*Davis*, 1957). Table 2-2 (c.f. *Emery*, 1978a) summarizes the linkage.

The redesigning of work leads beyond individual jobs to the organization of groups of workers and, beyond that, the organization of support services (such as maintenance). The wider implications

**Table 2-1**

| **Properties of jobs** | |
|---|---|
| *Extrinsic* | *Intrinsic* |
| Fair and adequate pay | Variety and challenge |
| Job security | Continuous learning |
| Benefits | Discretion, autonomy |
| Safety | Recognition and support |
| Health | Meaningful social contribution |
| Due process | Desirable future |
| Conditions of employment: Socio-economic | The job itself: Psycho-social |

affect organization design more generally. A congruent set of principles of work design and of 'core dimensions' of jobs has been identified by other writers (*Hackman and Lawler*, 1971; *Hackman, Oldham* et al., 1975; *Herrick and Maccoby*, 1975; *Walton*, 1975a; *Hackman and Suttle*, 1977). This degree of agreement is exceptional in so new a field and has placed work redesign on a firmer foundation than is commonly realized.

**Table 2-2**

| Principles of work design | |
|---|---|
| At the level of *the individual* | At group level – *interlocking where*: |
| Optimum variety of tasks within the job. | There is a necessary interdependence of jobs for technical or psychological reasons. |
| A meaningful pattern of tasks that gives to each job a semi-balance of a single, overall task. | The individual jobs entail a relatively high degree of stress. |
| Optimum length of the work cycle. | The individual jobs do not make a perceivable contribution to the utility of the end product. |
| Some scope for setting standards of quantity and quality of production and a suitable feedback of knowledge of results. | The linkages create some semblance of an overall task. |
| The inclusion in the job of some of the auxiliary and preparatory tasks. | There is some scope for setting standards and receiving knowledge of results. |
| The inclusion of some degree of care, skill, knowledge or effort that is worthy of respect in the community. | Some control can be exercised over the 'boundary tasks.' |
| The inclusion of some perceivable contribution to the utility of the product for the consumer. | Channels of communication are such that the minimum requirements of the workers can be fed into the design of new jobs at an early stage. |
| | Channels of promotion to foreman rank exist which are sanctioned by the workers. |

## Individual differences in motivation

A wide range of individual differences has been found in work force motivation. All workers do not want 'enriched' jobs or to take more responsibility. This was investigated by Hackman and Lawler (1971), whose findings indicate that employees with some desire for 'higher order' need satisfaction perform better and feel more positive when their jobs rate high on the 'four core dimensions', which are similar to those identified by Emery. Those whose motivational pattern is not particularly oriented to higher need satisfaction do not show so strong a pattern of association, though most of the correlations are in the same direction.

Much of the literature on job satisfaction has attached too much importance to responses given at only one point in time – especially to questionnaires. People change over time and learn through experience. Many workers do not know what their real feelings will turn out to be until they have had actual experience of redesigned jobs. They need to know also how far such jobs are likely to be an enduring feature of their work-lives or how much they represent merely a temporary change.

It makes a difference whether one is considering solely individual attitudes or also social change involving norms and values. Employees who have convincing evidence that their organization has committed itself – long term – to joint optimization are more likely to commit themselves than those who do not. This is especially so if they sense that the norms and values of the wider society are also changing in the direction of the new paradigm.

A work group offers scope for a range of abilities and preferences. There is more room for individual differences in work groups than in standardized individual work stations.

Motivation in the work place has been reconceptualized by Susman (1976) in terms of a theory of directed action, which draws on the object relations tradition in psychoanalysis (*Klein*, 1932, 1959) and on the work, deriving from Lewin and gestalt psychology, of Chein (1954, 1972). Directed action is transactional. It is connected with the completion of an object relationship. It is a molar concept coproduced by the characteristics of the object and the meaning which the subject imparts to the situation. The individual and the work place become directively correlated. This view enables Susman to spell out the conditions under which directed action can be incorporated into work design so that the individual experiences self-enhancement. These conditions are consistent with the principles summarized earlier and provide the enabling context in which commitment can develop.

## Work analysis

Needed also was a method for analyzing work systems. This had not only to be academically defensible but communicable to workers, managers and staff specialists who could, after some practice, become able to use it for themselves. The following nine-step model derives from the second field experiment of the Norwegian Industrial Democracy project at the Hunsfoss Paper and Pulp Mill which began in 1964 (*Emery and Thorsrud,* 1969, 1976) – where for the first time an 'action group' of workers, technicians and supervisors was created in order to diagnose the malfunctioning of the particular system they were concerned with. Emery was again the initiator. The condensed version, quoted below from Trist (1971), has been put in systems terms to make it as general as possible.

> 1) An initial scanning is made of all the main aspects – technical and social – of the *selected target system* – that is, department or plant to be studied.
>
> 2) The *unit operations* – that is, the transformations (changes of state) of the material or product that take place in the target system – are then identified, whether carried out by men or machines.
>
> 3) An attempt is made to discover the *key variances* and their interrelations. A variance is key if it significantly affects (1) either the quantity or quality of production, and (2) either the operating or social costs of production.
>
> 4) A table of variance control is then drawn up to ascertain *how far the key variances are controlled by the social system* – the workers, supervisors, and managers concerned. Investigation is made of what variances are imported or exported across the social-system boundary.
>
> 5) A separate inquiry is made into *social-system members' perception* of their roles and of role possibilities as well as constraining factors.
>
> 6) Attention then shifts to *neighboring systems,* beginning with the support or maintenance system.
>
> 7) Attention continues to the *boundary-crossing systems* on the input and output side – that is, supplier and user systems.
>
> 8) The target system and its immediate neighbors are then considered in the context of the *general management system* of the organization as regards the effects of policies or development plans of either a technical or social nature.
>
> 9) Recycling occurs at any stage, eventually culminating in *design proposals* for the target and/or neighboring systems.

This procedure was first used as a training method for departmental managers in the Shell Management Philosophy project in the U.K. (*Hill,* 1971). It has since been incorporated by Davis in the UCLA Short Course on QWL.

The model was originally tailored to the requirements of continuous process industries. A variant for office units was then introduced. While a number of alternatives are likely to be required for different technologies, the logic of relating any target system to the set of its surrounding systems would appear to be general.

## Autonomous groups and primary work systems

No one group in any organization can be completely autonomous. It can only be conditionally or semiautonomous. There are, nevertheless, several dimensions and degrees of autonomy. The most systematic analysis of these has been made by Susman (1976), who, building on an earlier paper by Gulowsen (1972), approaches this question by distinguishing three classes of decision: those concerning task independence, those concerning self-governance, and those concerning types of self-regulatory activity. He separates boundary-transaction uncertainty from conversion uncertainty and proceeds to introduce categories of technically required cooperation, type of interdependence, and type of coordination. These concepts provide a framework for the analysis of autonomy more rigorous than that previously available.

A socio-technical theory of the efficacy of autonomous work groups is based on the cybernetic concept of self-regulation. The more the key variances can be controlled by the group, the better the results and the higher the member satisfaction. Over a large array of situations, the range of variances controllable by a group is greater than that controllable by individuals separately linked to an external supervisor. The difference in the underlying design principle is summarized in Emery's concept of 'participant design' (1974, 1976). The function of supervision is to manage the boundary conditions in the group's environment so that the group itself may be freed to manage its own activities. This is a very different concept from the bureaucratic theory of control.

Autonomous groups are learning systems. As their capabilities increase, they extend their decision space. In production units they tend to absorb certain maintenance and control functions. They become able to set their own machines. The problem-solving capability increases on day-to-day issues.* They negotiate for their special needs with their supply and user departments. As time goes on, more of their members acquire more of the relevant skills. Yet most such groups allow a considerable range of preferences as regards multi-skilling and job interchange. The less venturesome and more modestly endowed can find suitable niches. The overall gain in flexibility can become very considerable, and this can be used to enhance performance and also to accommodate personal needs as regards time off, shifts, vacations, etc.

*Some of these features are found in the Japanese Quality Control Circles.

Autonomous groups do not always succeed. A good deal has become known about the conditions affecting their success or failure. These will not be reviewed here, except to note that one of the most common reasons for failure is lack of support in the surrounding organizational milieu. A year or two ago, my research center at the University of Pennsylvania carried out a study of 'work teams' in a very large organization. Of the 90 that had existed at some time during a 10-year period, only two were extant when the study was made. In addition to the effects of the mid-'70s recession in disrupting work teams through layoffs, a principal reason for failure was lack of support in the wider organization. When the initiator departed, 'fade-out' occurred (*MBSC*, 1978), no matter how successful the project was economically.

Autonomous groups of the face-to-face kind are not the only type of nonhierarchical social formation that has appeared at the level of the primary work system. Herbst (1976) points to 'matrix' type groups in which there is limited overlap between member skills which are too complex for all to learn. In such groups, there may be considerable spatial and temporal scatter. Herbst also mentions clusters of network roles which 'boundary span' across primary work systems and also connect subgroups within such systems. Matrix groups and network clusters are becoming prominent as organizational interdependencies increase. This is apt to happen to a greater extent in advanced technologies and in organizations with large and varied clienteles.

Confusion has been created regarding the number of individuals suitable for inclusion in autonomous work groups. Small group theory supports an upper limit in the 8-12 range. The Tavistock mining studies, however, showed that 'composite groups' tended to be much larger. A number of other studies have reported groups beyond the limit of the face-to-face range. These all tend to be complex groups with several subsets.

Another unit of analysis is required, namely the *primary work system*, which may include more than one face-to-face group along with others in matrix and network clusters. The primary work system is a functional system with a semi-independent operational identity, whether as a production or service unit. In the Saab 99 engine plant, all the assembly teams of three formed part of the same primary work system.

In a primary work system an individual is apt to have several group memberships. In the mining studies a miner considered himself as belonging basically to a 'seam society' in which he had established rights and privileges regarding employment and deployment. Within the seam he belonged to a face or cycle group; thereafter to a task group. This latter was more temporary than the former which, though focal, was less enduring than his seam belongingness.

These multiple but congruent memberships gave him considerable 'space of free movement' within a seam population of more than 100 people which still comprised a personal world. The seam group contained ancillary personnel, a district management system, and a complete territory, as well as all the equipment necessary for mining [c.f. Miller (1959) regarding the relations between territory, technology and time]. It constituted a *polity,* being a recognized worker constituency with representatives who conducted detailed negotiations for the seam within the overall union agreement for the colliery.

This was the type of group which Rice found in the automatic loomshed in Ahmedabad (though the overall number was smaller), which Melman found in the Standard Motor Company in Coventry (though the overall number was larger), and which Burden (1975) describes in the microwax plant in Shell's Stanlow refinery in Cheshire. In my own work I have found such groups in a number of situations, including Alcan's Reduction Division at Arvida, where the quite large divisional workforce served as a reference community for the on-shift task groups of six. It functioned as their polity, taking all decisions concerning self-governance – including the decision to accept the proposal (which its representatives took part in shaping) to try out autonomous work groups. The task groups made decisions concerning the self-regulation of their own activities.

Primary work systems of this scale and this complexity are the type of socio-technical unit which is emerging at the present time in a number of new plants in North America. Cummins Engines' diesel plant in Jamestown, N.Y. (*Pava,* 1979) and Shell's petro-chemical plants in Sarnia, Ontario (*Davis and Sullivan,* 1980) are examples. In the latter the workers have the possibility of learning not only all the process jobs, but also a coordinating or service job in instrumentation, the lab, quality control, maintenance, etc. An advantage from their point of view is that they can maximize their time on days (over 50 percent) – a cherished improvement as regards the work-home interface.

Such arrangements increase the competencies that may be acquired, the number of deployment patterns available, and the career paths open. For the individual they create *roles* rather than mere jobs. For the organization they bring into being a *variety-increasing system* directively correlated with the complexities and interdependencies of the technology. Emery (1980) has described an elaborate system of this kind in a new metal mine in Australia where there is paramount need to share information and for all to have a cognitive map of the entire process. This cognitive map is the essential system control which has now become a new 'dissipative structure' (*Prigogine,* 1968) in the workers themselves. It represents a 'morphogenetic' change. The penalties of not evolving socio-technical systems of this kind have been suffered in more than one nuclear power plant.

Complex primary work systems will increase as computer-aided continuous process technology advances. Group, or cellular, technology offers a parallel opportunity in batch production (*Williamson*, 1972). These areas need an intensification of research efforts.

Multiple memberships in a larger group which comprises a *social aggregate* may be postulated as lessening the dangers of overinvestment which can easily occur if the individual is bound too exclusively in one face-to-face group. These dangers have been investigated by Miller and Rice (1967) in their work on the relations between task and 'sentient' group boundaries. The benefit in greater cohesion consequent on the coincidence of these boundaries tends to be offset by a greater propensity to self-sealing. The presence of a social aggregate introduces properties into a primary work system different from those of the constituent task groups (c.f. *Churchman and Emery*, 1966). It constitutes the ground on which they are the figures. To have some ground of its own on which to stand increases the power of a group in a wider organizational setting to relate to other groups having similar standing. This enables the members of a primary work system to become a polity. The ability of the system group to become a polity or worker constituency relates it directly to the trade-union organization. This may undo many fears which union people have concerning autonomous groups – that even though the consequence may be unintended, their effect will be to undermine the union by bringing into being a competing loyalty.

The development of self-standing primary work systems containing mixes of groups with commonly shared skills, matrices whose members have partly overlapping skills and networks of mainly specialist skills constitutes a new basis for the effectiveness of socio-technical organizations. They create organizational units of considerable 'robustness' which compose 'microsocieties' which have intragroup, intergroup and aggregate relations with a whole operational task. These microsocieties provide considerable space of free movement to the individual and are open to the interorganizational environment.

Self-standing primary work systems exemplify a holographic principle of organization in which the whole is represented in the part (*Pribram*, 1977). The forms through which holographic primary work systems may best become linked to the overall organization constitute an area requiring further research. The question is not so much that of small being beautiful as of finding ways of retaining small in large so that the advantages of both may be realized. Open systems planning as developed by Clarke, Krone and McWhinney (*Jayaram*, 1976; *McWhinney*, 1980) would seem to offer a promising new approach to this problem.

# 3 Developments in whole organization systems

Very early on in socio-technical studies it became evident that innovations in work organization based on principles different from those on which conventional bureaucratic organizations were founded were not likely to survive for long unless the organization as a whole changed in the new direction. Joint optimization involves a different principle from following the technical imperative. The group-centered primary work systems which are evolving in relation to it are radically different from the one-man-one-job units upon which conventional organizations have built their top-down hierarchies.

The basic difference constitutes what Emery and Trist (1973; *Emery*, 1967) have called a *design principle*. There are two basic organizational design principles, both of which display 'redundancy' in the systems theoretic sense. In the first, the redundancy is of parts and is mechanistic. The parts are broken down so that the ultimate elements are as simple and inexpensive as possible, as with the unskilled worker in a narrow job who is cheap to replace and who takes little time to train. The technocratic bureaucracy is founded on this type of design. In the second design principle, the redundancy is of functions and is organic. Any component system has a repertoire which can be put to many uses, so that increased adaptive flexibility is acquired. While this is true at the biological level, as for example in the human body, it becomes far greater at the organizational level where the components – individual humans and groups of humans – are themselves purposeful systems. Humans have the capacity for self-regulation so that control may become internal rather than external. Only organizations based on the redundancy of functions have the flexibility and innovative potential to give the possibility of adaptation to a rapid change rate, increasing complexity and environmental uncertainty.

'Rational' choice between the two design principles must take the state of the wider social field into account. One is led back to the macrosocial level, the increasingly disturbed state of which was drawn to the attention of Emery and myself (1963). In action research projects with which we were concerned at that time, both our organizational clients and we ourselves were baffled by the extent to which the wider societal environment was moving in on their more immediate concerns, upsetting plans, preventing the

achievement of operational goals and causing additional stress and severe internal conflict. The magnitude of this impact was recognized by those concerned as greater than any previously experienced. The difference seemed to us to hold theoretical significance. Accordingly, we separated this wider environment, which we called the contextual, from the more immediate transactional environment and attempted a conceptual analysis of its characteristics.

Four types of contextual environment were isolated. The first two, called the random placid and the placid clustered, need not be discussed in the present context. The third environmental type, however, called the disturbed-reactive, reflects an accelerating change rate and became increasingly salient as the industrial revolution progressed. It zenithed some time after World War II when the science-based industries rose to prominence in the wake of the knowledge and information explosions. The best chances of survival in this world went to large-scale organizations with the capacity to make formidable competitive challenge through expertise and to maximize their independent power. The organizational form they perfected was the competitive and singular technocratic bureaucracy in which the ideas of Weber and Frederick Taylor are matched and operationalized to fit the requirements of the disturbed-reactive environment.

The very success of the technocratic bureaucracy has increased the salience of another type of environment, very different from the disturbed-reactive, which is mismatched with technocratic bureaucracy. The new environment is called the turbulent field in which large competing organizations, all acting independently in diverse directions, produce unanticipated and dissonant consequences. These mount as the common field becomes more densely occupied. The result is a kind of contextual commotion which makes it seem as if 'the ground' were moving as well as the organizational actors. This is what is meant by turbulence. Subjectively, it is experienced as 'a loss of the stable state' (*Schon,* 1971).

As compared with the disturbed-reactive environment, the turbulent field is characterized by a higher level of interdependence among the 'causal strands' (*Chein,* 1954) and a higher level of complexity as regards heterogeneity. Together these generate a much higher level of uncertainty. The turbulent field has the characteristics of a richly joined environment in Ashby's (1960) sense. He did not think the brain, as an ultra-stable system, could cope with such an environment. While this may be true in other species, the human brain, through its unusual capacity for abstraction from the concrete (*Goldstein,* 1939), is able to think in terms of 'possible worlds'. This enables man to be 'ideal seeking', which Ackoff and Emery (1972) regard as the distinctively human attribute. The importance of ideals is that they can never be reached but provide continuous 'guiding fictions' (*Allport,* 1937) in the pursuit of changing objectives and

goals. Ideals are basic to value formation, and when common values are shared by large numbers of people they become able to undertake congruent courses of action. They can move in the same direction on the basis of 'shared appreciations' (*Vickers*, 1965). These are independent of particular social structures. The adaptability imparted would appear to be basic for the capacity to cope with environmental turbulence. The most recent analysis of this is by Emery (1976).

The higher levels of interdependence, complexity and uncertainty now to be found in the world environment pass the limits within which technocratic bureaucracies were designed to cope. Given its solely independent purposes, its primarily competitive relations, its mechanistic authoritarian control structure and its tendency to debase human resources, this organizational form cannot absorb environmental turbulence, far less reduce it. But such absorption and reduction are a necessary condition for opening the way to a viable human future.

In Sartre's sense, the technocratic bureaucracy has been 'depassed' in the historical process. Though Galbraith (1967) has referred to it, and the disturbed-reactive environment to which it is linked, as the 'new industrial state', these are both better seen, McLuhan-wise, through the rear-view mirror, as the old industrial state. Once one has become freed from past fixations in this regard, one is able to proceed with the evolution of values, cognitive orientations and organizational modalities capable of matching up to the precarious state of affairs now looming in the contextual environment.

Emergent organizational forms likely to have adaptive potential in this situation must be able to cope with the new levels of interdependence, complexity and uncertainty.

## New plants

A major problem for socio-technical research now arose – the identification of an organizational model which would offer an alternative to that of the conventional technocratic and bureaucratic types of organization. Theoretically, one could expect to found it on the second design principle of the redundancy of functions. The hypothesis was made that the most likely place to find examples of an emergent alternative would be among new plants in the science-based industries. Accordingly, opportunities were sought for action-research engagements with companies bringing such plants on stream and willing to explore alternative designs with the help of social scientists.

In the latter part of the 1960s, a number of new plants of this kind came into existence in different countries. Projects in which social scientists were involved included a fertilizer plant in Norway, a

refinery in the U.K., an aluminum fabrication plant in Canada, a consumer products and pet food plant in the U.S.*

Given well developed primary work systems, these plants had fewer levels, functions and numbers of management personnel than conventional plants. The numbers in the workforce were also lower – often a third lower. Payment was for knowledge, not for what a person did at a particular time, so that individuals could evolve progressive work roles no longer confined by job classifications which rigidly defined wage differentials and statuses. Foremen were either nonexistent or became facilitators, trainers and forward planners. Information was shared for the purpose of problem-solving, which became the task of everyone, not only of management. This principle gave an underlying logic to management's adopting a participant style.

Performance levels were usually above those of conventional plants with which they could be compared. Moreover, these levels improved through time. The plants were learning systems. Employees, who tended to be volunteers and who were carefully selected, preferred them to conventional plants. A number of others preferred to stay where they were.

In the last two or three years, the number of new plants developed on these lines has increased very considerably, especially in the United States. In the latest versions, the social aspect has been considered much earlier so that the ideal of joint socio-technical design is being more closely approached.

Another socio-technical design principle that has begun to affect practice is 'minimum critical specification' (*Herbst*, 1974). Only the essentials are decided a priori; as much as possible is left open to be decided at later stages, even when the plant is already in operation. The principle allows the progressive involvement of those concerned – at all levels. The barriers between planners and implementors are reduced. Design and operations are seen as a continuous process.

Socio-technical design has now come to include a large number of factors of context, sanction, stakeholder inclusion and processes

*The firms were respectively: Norskhydro, Shell, Alcan, Procter and Gamble and General Foods. The social scientists concerned were part of an evolving socio-technical network: Davis, Emery, Thorsrud, Trist, Walton. The first four all took part in the Norwegian Industrial Democracy project, which Walton visited later. Davis joined Emery and Trist for a while in the Tavistock's project with Shell. Davis and Trist both came to UCLA, where they held a seminar which began the work with Alcan and also with Procter and Gamble (through Clarke). Walton spent a sabbatical year at UCLA. He later began the work with General Foods that Trist eventually became involved in. Hill (Shell), Cameron (Alcan), Krone (Procter and Gamble), Ketchum (General Foods) were key people involved on the companies' side.

of implementation as well as joint optimization of the social and technical systems. A set of principles based on these factors has been put forward by Cherns (1976) and Davis (1977).

## New and old organizational paradigms

These plants exemplify the model which new installations are likely to emulate during the eighties. Beyond that, they may be hypothesized as foreshadowing a new organizational paradigm which, as time goes on, will displace the old paradigm of the technocratic bureaucracy. This displacement will come about because the new form has the flexibility and the resilience to cope with turbulent environment fields, whereas the old form lacks these capabilities. It will use less resources in so doing; it will be efficient as well as effective (*Trist*, 1979b). Table 2-3 sets out the key features of the new organizational paradigm which can potentially lead to a high QWL for all members of the enterprise. They contrast strongly with those of the old organizational paradigm, set out on the left, which has been instrumental in constraining most employees to a low QWL.

Our traditional organizations follow the technological imperative which regards man simply as an extension of the machine and therefore as an expendable spare part. By contrast, the emergent paradigm is founded on the principle of joint optimization, which regards

**Table 2-3**

| *Old Paradigm* | *New Paradigm* |
|---|---|
| The technological imperative | Joint optimization |
| Man as an extension of the machine | Man as complementary to the machine |
| Man as an expendable spare part | Man as a resource to be developed |
| Maximum task breakdown, simple narrow skills | Optimum task grouping, multiple broad skills |
| External controls (supervisors, specialist staffs, procedures) | Internal controls (self-regulating subsystems) |
| Tall organization chart, autocratic style | Flat organization chart, participative style |
| Competition, gamesmanship | Collaboration, collegiality |
| Organization's purposes only | Members' and society's purposes also |
| Alienation | Commitment |
| Low risk-taking | Innovation |

man as complementary to the machine and values his unique capabilities for appreciative and evaluative judgment. He is a resource to be developed for his own sake rather than to be degraded and cast aside. As my former Tavistock colleague Phil Herbst (1975) has aptly observed, 'the product of work is people,' as well as goods or services. A society is no better than the quality of the people it produces.

Traditional organizations are also characterized by maximum work breakdown, which leads to circumscribed job descriptions and single skills – the narrower the better. Workers in such roles are often unable to manage the uncertainty, or variance, that characterizes their immediate environment. They therefore require strict external controls. Layer upon layer of supervision comes into existence supported by a wide variety of specialist staffs and formal procedures. A tall pyramidic organization results, which is autocratically managed throughout, even if the paternalism is benign. By contrast, the new paradigm is based on optimum task grouping, which encourages multiple broad skills. Workers in such a role system (as opposed to a job system) become capable of a much higher degree of internal control, having flexible group resources to meet a greater degree of environmental variance. This leads to a flat organization characterized by as much lateral as vertical communication. A participative management style emerges with the various levels mutually articulated (c.f. *Parsons,* 1960) rather than arranged in a simple hierarchy.

In the traditional organization each member has first of all to compete with and defend himself against everyone else, whether as an individual or as a member of a functional group – maintenance versus production, staff versus line. Rewards such as promotion and privilege go to those who, in the metaphor introduced by Michael Maccoby (1976), are 'gamesmen' – those who excel in playing the political game of the organization. Cooperation, though formally required wherever tasks are interdependent, takes second place as a value. The new paradigm, by contrast, gives first place to coping with the manifold interdependencies that arise in complex organizations. It values collaboration between groups and collegiality within groups. It encourages the establishment of a negotiated order in which multiple and mutually agreed tradeoffs are continuously arrived at.

Traditional organizations serve only their own ends. They are, and indeed are supposed to be, selfish. The new paradigm imposes the additional task on them of aligning their own purposes with the purposes of the wider society and also with the purposes of their members. By so doing, organizations become both 'environmentalized' and 'humanized' (*Ackoff,* 1974) – and thus more truly purposeful – rather than remaining impersonal and mindless forces that increase environmental turbulence.

A change in all these regards from the old paradigm to the new brings into being conditions that allow commitment to grow and alienation to decrease. Equally important is the replacement of a climate of low risk-taking with one of innovation. This implies high trust and openness in relations. All these qualities are mandatory if we are to transform traditional technocratic bureaucracies into continuous adaptive learning systems.

This transformation is imperative for survival in a fast-changing environment. It involves nothing less than the working out of a new organizational philosophy.

I use the term philosophy advisedly to indicate that far more is involved than methods or techniques. These, of course, have their place, but a philosophy involves questions of basic values and assumptions. Those of the new paradigm are radically different from those of the old. The old is based on technocratic and bureaucratic principles, the new on socio-ecological and participative principles. Each subsystem has a wide repertoire of response capability. It can thus better meet uncertainty and contain turbulence. This is one of the most important features of self-regulating systems – both autonomous work groups and open, mutually-articulated organizational levels. The old is geared to the requirements and characteristics of industrial societies as these have been fashioned historically. The new is geared to the requirements and characteristics of the emerging post-industrial order. At present, we are in a transition channel between the two. A transition channel is always an uncomfortable place to be, full as it is of incompatibilities and mirages. Is there wonder that we have lost the stable state?

Innovative projects in new plants take advantage of privileged circumstances to demonstrate the reality of paths into the future which would otherwise remain no more than untested possibilities. They represent the fullest embodiment of the new model so far attained.

## Established work organizations

In established plants one has to deal with those already there, among whom are those who don't want to change or whose limitations of ability or forms of character prevent them from changing. The accumulated practices of the past are present along with an array of vested interests. If the plant is unionized, there will be fear on management's part of surrendering prerogatives and on the workers' of compromising the union's independence. Yet there has to be some agreed sharing of power if success is to be attained. Sharing of power is a basic principle of the new model.

In established plants, progress has been at best slow; at worst the change effort has had to be abandoned. New methods of process consultation seem required. Ketchum (1975) has evolved a practice of uncovering what Argyris and Schon (1974) would call 'theories

in use' as distinct from 'espoused theories'. He attempts to unprogram key participants from deep implicit attachments to the 'traditional system' before anything new is proposed. But to cover a whole organizational population in this manner poses problems as yet unsolved in change efforts with social aggregates. Yet whole organizational populations are what one must deal with at this system level.

A dilemma now arises. The way forward would seem to lie in what is being developed in new innovative work establishments. These innovations, however, are resisted in many if not most conventional establishments. Even where they are welcome, substantial change cannot be introduced across the board. Yet where such change is left only in one section of a plant or only in one plant in a corporation, more often than not it fades out or is actively stopped. In most of the plants mentioned earlier, so great were external pressures to conformity that sooner or later they underwent some regression toward the conventional mode (*Hill,* 1971; *Walton,* 1975b). For the most part, their example was rejected by other units in their own corporations, though they received large numbers of visitors from other organizations who not infrequently adapted some of what they saw to their own purposes. Whatever the course of diffusion, it is not linear.

## Change strategies

Given the increasing salience of turbulent environmental conditions likely in the eighties, there is need to hasten the transformation of established organizations towards the new paradigm. To discover how this may be better attempted constitutes a priority for socio-technical research.

Below is a sketch of how far my own thinking has progressed in this matter. It is based on a theory of the appreciation-planning-implementation process which I am working out with my Wharton colleague, Howard Perlmutter, in a book we are at present struggling with.

The first step is to secure an appreciation (*Vickers,* 1965) of the issues at the highest level of the corporation or agency (the institutional level, as Parsons (1960) called it – the level of governance as *distinct* from 'management'), the level at which normative planning (*Ozbekhan,* 1969) takes place. At this level, critical choices concern organizational values and philosophy. A methodology which has been evolved for working at this level is the 'search conference' (*Emery and Emery,* 1978). The board, the president and the vice-presidents (the overlap is important) go off-site for two or three days to scan the wider environment in a futures perspective, to review the present state of the organization in relation to this perspective, then to discover how far they can create a shared image of a desirable organizational future and finally to consider action steps towards

this, having regard to the constraints. The Tavistock project with Shell (U.K.) began in this way. A 'philosophy document' – based on a working draft jointly produced by the internal and external research teams, was sanctioned at a top management retreat and then checked out at residential conferences – held with all levels, including the shop floor. An organizational population of 6,000 employees was reached in this way. Many varieties of this type of procedure are likely to be tried.

The next step, at the strategic level of management, is concerned with a process which I have called 'selective development' (*Trist*, 1979b). Since change cannot take place at all points at the same time, the plants or other self-standing establishments where socio-technical change is most needed and most likely to be accepted have to be identified. To do this is a vice-presidential function, but the vice-presidents need to do it collectively with the president. If they have not participated in the normative meetings, they will not 'appreciate' what is required.

A third step consists of selecting concrete project sites within plants or other self-standing work establishments. The plant manager (if he has bought into the philosophy) would now consult with a cross-section of his managers at all levels. As early as possible he would include the union. If there is no union, some way has to be found of involving the work force. Procedures at this operational level would tend to be more idiomatic, given the great variety of circumstances.

Ultimately, what Emery (1976) has called a 'deep slice' (a task force of workers, foremen, specialists) may be selected to carry out an investigation and make recommendations on what might best be done at a given project site in consultation with those directly involved – who would have to 'own' the project or nothing much would happen.

At the operational level, joint labor-management steering committees have a key function in deciding on, assisting and evaluating project sites. In the U.S. they have been developing in the socio-technical field, though with many vicissitudes, since the beginning of the program of the then National Commission on Productivity and Work Quality in 1973.

One or two firms such as General Motors have now included the union in strategic and normative level conferences. This is a pointer to the future. The union may indeed initiate the whole process in its own interest as a union, as the U.A.W. did with G.M. in introducing humanization of work clauses into the 1973 agreement.

The process described above derives from a theory of change based on the idea of stakeholder participation. Those interest groups who have a stake in what is being decided are represented at every step

(in overlapping sets much as in Likert's (1961) linking-pin theory) down, up – and across. There is scope for 'experimentation' in involving the social aggregate in open meetings at shop floor level – the micro-societies of primary work systems; combinations of such systems; even the entire plant population.* Foremen and junior staffs may require their own aggregate meetings. In the future, various levels within management are likely to formalize their own reference groups. They have already done so in several European countries. The kinds of people inside and outside the organization claiming stakeholder status are likely to increase.

It is further hypothesized that this type of process would not be embarked upon unless those concerned had come to believe that socio-technical change in the direction of the new paradigm was a long-term process contributing to enhanced organizational capability relevant to coping with rising contextual turbulence. The ultimate motivation is survival.

Change of this type, which involves the discontinuity of a paradigm shift, is an emotional as well as an intellectual experience for those undergoing it. Prolonged opportunities need to be given for 'working through' the difficulties and issues that arise at many levels – conscious and unconscious. The structure and culture of organizations have evolved as an adaptation to the prevailing societal environment. People have learned to make this adaptation with considerable effort. Many of their ego defenses are projected into the existing structure and culture (*Trist and Bamforth*, 1951; *Jaques*, 1953; *Menzies*, 1960). They have formed their occupational identities in relation to them. They now find themselves faced with having to give up what it has taken a long time to learn and to become. Whatever its shortcomings, the status quo is familiar and has been internalized. Change involves loss (*Marris*, 1975). Room must be left for mourning in both its depressive and angry phases. To face the novel (which may not work) stirs up deep anxieties which easily evoke paranoid phantasies.

Such a situation of loss and threat may be expected to induce regressive behavior in the members of organizations undergoing radical change. This manifests itself at the group level by an increase in the frequency with which the primitive emotional cultures associated with what Bion (1961) has called 'the basic assumption' group

*At Bolsover colliery in Britain in 1953, the Divisional Chairman with the Area General Manager held a meeting with the entire colliery (1,800 men) to decide whether or not to go ahead with a new method of continuous mining involving autonomous work groups and which would create 600 redundancies. Such meetings cannot be successful without intense preparation. In this case, the union and management jointly interviewed every man and decided whether he was to stay or go. If he was to go, arrangements were made for his transfer to another mine (including housing), or job placement assistance was given in collaboration with the Ministry of Labour if he wished to leave the industry. Walton and Slesinger have been recently trying out town meetings in certain plants (personal communication).

intrude into the behavior of what he has called the 'sophisticated' group. These intrusions are unconscious. They obstruct the sophisticated group in carrying out its primary task – the work it was brought into existence to perform. Such a concept of work is wider than paid employment. It refers to the transactions which any group has to carry out to maintain a steady state in relation to its environment. These transactions are necessary because the group has only an incomplete control over this environment whose resources it needs to achieve its ends. A transactional concept of work is analogous to the psychoanalytic concept of the ego as the institution in the personality mediating between the internal and external worlds.

Change which involves discontinuity, as a paradigm shift does, requires deutero-learning in Bateson's (1972) sense. This, as he says, is frustrating. The pain of this frustration is a cause of the resistance which Bion has referred to as 'the hatred of learning through experience.' The new patterns can only be discovered by the individual and the group members when they undergo an experience through which they themselves can establish the validity of the patterns. Intellectual presentations are valuable in hindsight. They permit rational understanding of what has transpired. They are of small avail as reasons for undertaking the initial steps. The work of Bateson and Bion on these questions has recently been extended to the field of organizational change by Pava (1980).

A vision of a possible alternative mode is a necessary condition for bringing about substantial change. Hence the importance of articulating a new philosophy which embodies the vision. But the vision and the philosophy make little sense to most of those concerned until the process of enactment begins (*Weick*, 1979).

In the early Tavistock work in the socio-technical field, the task and process orientations were unified. Later they became separated. This has led to negative results. Members of middle management have perhaps exhibited the most solid forms of resistance. This became apparent during the Norwegian Industrial Democracy project when an attempt was made to diffuse socio-technical change throughout the largest enterprise in the country (Norshydro). Some 500 middle managers, sensing all loss and no gain so far as they were concerned, said no. More thorough-going process intervention might have helped this group to work through their problems at an earlier stage.

The recent trend in the United States to fuse the socio-technical and organizational development traditions is welcome. The ecology of work meetings conducted by the National Training Laboratories are being attended by increasingly large numbers of people. Emphasis has been placed on process skills as well as work analysis skills in the national workshops conducted to train QWL facilitators sponsored by the Canadian Department of Labor.

The traditional skills of organizational development have had little success with organized labor. The trust level is usually too low and the political understanding of the facilitators too inconsequential. The conflicts between management and labor are of a different character than those within management and require different methods of conflict resolution. Facilitators tend to be ignorant of labor relations and trade union history. This ignorance is not forgiven.

The new fields opening up in organizational change are conveying the message that established notions of the change-agent are outmoded. He needs to unlearn the role of being an expert and to learn the role of being a contributor to a process of co-learning. In this process all stakeholders make their resources available without claiming special privileges of role or status. This was learned many years ago in therapeutic communities by their originator, Maxwell Jones (1968, 1976), who has recently attempted to unify process theory for the clinical and non-clinical worlds.

The reunification of the task and process aspects of socio-technical projects is a central task for future research and practice. It needs to be undertaken in terms of the emerging concept of a learning society. If the paradigm for alternative organizations – those capable of surviving environmental turbulence and eventually reducing it – requires their democratization, it also requires the democratization of the relations of those concerned with organizational change. This will entail breaking down the barriers between the changers and the to-be-changed. The ideal is pentecostal – that all parties speak with tongues.

# 4 Developments at the macrosocial level

In the socio-technical field as a whole, the knowledge base is unevenly distributed. Most is known about primary work systems and a good deal about modeling new plants. Far less is known about transforming existing work establishments. Even less, however, is known about socio-technical processes at the macrosocial level. The payoff from directing research attention to this level would be considerable.

## The microprocessor revolution

As regards macrotechnological trends, the advent of the microprocessor and related electronic technologies may be regarded as an event of prime consequence. Many think that a fifth Krondradieff cycle has now started. A lead technology has been associated with each of these cycles since the beginning of the Industrial Revolution. Microprocessors are the lead technology of the new cycle (*Emery*, 1978b). The French have introduced the word télématique to denote the link with communications.

A number of questions and issues arise:

1) This family of technologies has applications in all industries, whether manufacturing or service. It is a 'universal' with consequences which are pervasive. Its possible impact over the whole field has to be examined, choices made and policies worked out. Otherwise the process will run blind.

2) Mass unemployment is likely unless offsetting measures are drawn up in advance. Simplifications and cost reduction are possible in some sections of the engineering industry where layoffs have been estimated at 80 percent (*Emery*, 1978b). Word processing is likely to occasion similar personnel shrinkages in many white collar occupations, which will not be able to absorb those made redundant from manufacturing as they did during the first round of automation. Jenkins and Sherman (1979) forecast an overall reduction of 23.2% in the British labor force by the year 2000 and identify high-risk job functions and sectors.*

*They entitled their book *The Collapse of Work*. The senior author is a major trade union leader – his would appear to be the most comprehensive statement on the issue from a union standpoint.

3) The opportunities for decentralization are unprecedented, provided they are taken. According to the value choices made, they could lead in the opposite direction.

4) The opportunities are not only for decentralization, but for democratization. Since a step-function increase in two-way communication is now becoming possible, large-scale dialogue will be feasible. Public learning systems, as imagined by Schon (1971), especially in relation to government, could be created (if people want them – and are not stopped from developing them).

5) The socio-technical systems involved are not confined to work organizations. They include the built environment – the urban scene, the home – and travel, leisure, etc. Proactive consumer linkage with selling organizations represents another new field.

6) The designers of new technologies dependent on computers and telecommunications belong to engineering disciplines far removed from socio-technical considerations. Unless educated to the contrary, they will follow the technological imperative and mortgage a good deal of the future. As with the industrial engineer, the strategy of choice would be to open up collaborative projects with them. A colleague of mine, formerly at York University, Toronto, himself a computer scientist, has begun a project with system builders on the hypothesis that if they will look at the quality of their own worklife, this will be a step towards inducing them to look at that of users.*

Advanced Western societies are on the threshold of a profound change in the texture of their socio-technical relations. This entails a change not only in quantity but in quality. It represents a discontinuity, as witness the opportunities for scaling down rather than up, dispersal rather than concentration, and self-management rather than external control. For the first time since the Industrial Revolution, a major class of technological forces is supportive (*in potentia*) of efforts to countervail some of the main negative impacts of that revolution on society.

*The meaning of work and alternatives to employment.* Simply to shorten the work week by a day or to propose some equivalent device is unlikely to provide a solution to unemployment on the scale anticipated in the eighties and nineties, particularly when, in addition to microprocessors and industrial robots, further displacement of industry to the Third World is taken into account. The meaning of work itself will need reconsideration. Sachs (1978) has suggested that work in the sense of paid employment will have to be rationed – though it would presumably be possible for the work addicted to purchase work stamps from the less addicted! In addition to his

*R. Fabian. Personal communication.

paid work, an individual would have an occupation in the 'civil society,' i.e., the community. This concept is consonant with that of the dual economy (*Robertson*, 1978) in which gift and barter arrangements grow up in a 'social economy' which exists in parallel with the market economy. The social economy includes activities which people undertake for themselves by way of self-reliance. These various activities comprise socio-technical systems that merit research as well as those connected with what conventionally passes as the world of work. They may involve community workshops and many new types of social arrangement. 'Jobs' in this area tend to be of high quality and to promote personal growth. They may, as a trade off, increase the tolerance for restricted jobs in employment, or they may increase the demand for more interesting jobs. They may be hypothesized to make the ordinary world of work less central and to make ambition or status in it less preoccupying than it is at present – at least for some kinds of people. There will be more choices in lifestyles, more types of career path open. Allied to this is a reassessment of the household as a work field that reflects the changing roles of men and women in the domestic socio-technical system and the links of this system with outside employment. The divorce between home and work, which has been so complete in industrial societies, may be less complete in the postindustrial order.

*Decentralization*. The logic of production since the Industrial Revolution has concentrated the employee in a large workplace and the citizen in a large urban area. The new information technologies can radically offset this pattern. Several possibilities may be noted:

1) The scaling down of particular work establishments in large organizations – the attainment of small in large. These establishments will tend to take on the character of self-regulating primary work systems only loosely attached to the larger entity.

2) Increasing numbers of primary work systems will become independent businesses linked to others in a network rather than contained within an organizational boundary.

3) Much more work will be done at home rather than in a separate place of work. This trend is likely to be linked to life phases (as regards the presence of young children and the elderly), to serial careers, and to the greater plasticity of sex roles. Again, more diversity becomes possible.

4) The effect of these trends on urbanization, the types of houses built, schools, the journey to work, etc., is likely to be far-reaching. Once again, more choices become possible than the continuation of current patterns.

Socio-technical research needs to monitor emergent alternatives, establish criteria for making choices more explicit and participate in action-research in selected projects.

## Technological choice

*Appropriate technology*. The appearance of the appropriate technology movement has widened the scope of socio-technical studies by bringing in the question of choice of technology in a new way. The appropriate technology is that which best fits the total circumstances which are the case: those indirectly as well as those directly affected, the long term as well as the short term, and the physical in addition to the social environment. This movement began with an analysis of the 'appropriateness' of what Schumacher (1973) called intermediate technology for the Third World. New arguments have since been raised concerning the elitism of high technology in the First and Second Worlds (*Henderson*, 1978). So far as a few only can understand a particular technology, there is danger of too great a concentration of expert power. If the technologies in question require very large capital inputs, there is the danger of too great a concentration of financial power, whether in the hands of corporations or governments. These are valid questions. To raise them, however, does not preclude the possibility of developing mechanisms of democratic control over high technology. This is an area of institution-building which socio-technical studies should enter. Similarly, questions of hard versus soft energy paths (*Lovins*, 1976) or mixes of these should be investigated from a socio-technical point of view.

*End product use*. This is another area the appearance of which issues a new challenge to socio-technical studies. A signal of social significance was given by the Lucas Aerospace Combined Shop Stewards Committee in Britain (*Cooley*, 1977), who proposed the manufacture of alternative product lines to those currently being produced by their management. The reasons were vintage union arguments – the stewards had concluded that the current lines were unlikely to survive in the marketplace and that their jobs were at risk. The alternatives proposed were of an appropriate technology type which provided an insight into the values of the workforce. Though at first rejected by management, the Committee sold several of its ideas to other companies – one to Volkswagen. In a recent report (*Coates and Topham*, 1980), an account is given of the feelings of joy experienced by workers who had designed and made an improved wheelchair for paraplegics. Worker initiatives of this kind have been taken in several companies following the Lucas example. One of the six criteria of psychological satisfaction at work is the worker's feelings concerning the end-use of the product to which he contributes. If he perceives it as trivial, harmful or as a loser, he is likely to be negatively affected. These concerns may be expected to rise in the next two decades. Sachs (1978) has distinguished between pseudo-value and value in end-use. Chevalier (1978) has elaborated

this notion in his concept of demand innovation. Those organizations sensed by their members at all levels to have the capability of contributing to some kind of desirable social future are the most likely to secure their commitment and to engage their effort. This is a break with the traditional market concept which, as Chevalier says, has been promoted from the supply side. This break may be postulated as likely to become wider in the decades ahead. Socio-technical studies should monitor it.

## Systems larger than the single organization

*The industry level.* I have argued elsewhere (*Trist,* 1976) that Western industrial societies are weak in the middle. Too little effective social structuring is available between institutions concerned with the management of the overall societal aggregate and the single organization. This deficiency puts excessive stress on both government and the corporation. The intermediate level consists of what I have called 'domains', one example of which would be an industrial sector. Special interest attaches to any work which has been done at this level. One example is that which Thorsrud and his colleagues have for some years been engaged in – a collaborative project with the Norwegian Shipping Industry (*Herbst,* 1976) which had entered critical conditions in a number of respects. An industry such as this comprises a system of 'organizational ecology' (*Trist,* 1977a).* Though all the organizations belonging to the system are closely independent, no single one is in overall control. If the bureaucratic paradigm were followed, the danger is that a form of corporatism might emerge which would lead in a totalitarian direction. The new institution-building task is to discover an alternative route based on participative and democratic principles which can secure inter-organizational collaboration.

In the Norwegian shipping industry, an experiment was carried out in the design and trial of sophisticated bulk carriers. This has led to a further innovative step; for, though many technological alternatives were available, the chosen design was that which met most fully the needs of the small shipboard community which had to live together under isolated conditions 24 hours a day for considerable periods of time, while simultaneously undertaking all the work tasks. A common recreation room – as well as mess – was established where all ranks could socialize (and drink together rather than be isolated with a bottle in the cabin). Deck and engine room crews were integrated and status differences between officers and men

*The terms social and organizational ecology are not used in Aldrich's (1979) sense, which is close to biological usage and emphasizes determinism, but as in Emery and Trist (1973) in a systems sense where an ecological system is taken as a set of interdependencies in which no one entity can control the others. Nor can it succeed apart from them. It constitutes a non-hierarchical field with open system characteristics in relation to its environment. It is composed of purposeful systems (organizations) which have to align their purposes with each other and with those of their members, since they are directively correlated with both (*Sommerhoff,* 1950, 1969).

were reduced, or even eliminated, through the development of open career lines on one or two 'all officer' ships. Serial career structures also have been accepted, and training for a future job on shore can now be begun at sea.

Without these steps, not enough Norwegians would have gone to sea to sustain the Norwegian Merchant Navy, which is critical for the balance of payments (even since the discovery of North Sea oil). Poorly educated and transient Southern European crews could not cope with technically sophisticated ships, and alcoholism, even among officers, was dangerously high. These problems could not be effectively tackled at the level of the single company. Moreover, competition was not so much between Norwegian companies as with foreign fleets. Several critical issues had to be taken up at the level of the industry concerning the types of decision to be left to those at sea and the types to bring ashore to headquarters and dockyard establishments. The technology was available to go either way. In the end, a very great deal was left to those manning the ships. The several seafaring unions, as well as the companies and various maritime regulatory organizations, took part in the discussions; these have produced a continuous learning process. The Norwegian experience was presented to the Maritime Commission of the Academy of Sciences (*Davis,* et al., 1972) when the question arose of re-expanding the U.S. Merchant Navy. To secure the collaboration of the many interest groups involved has proved difficult but some progress has been made (*Cohen-Rosenthal,* 1980). There are several industries and also social sectors where pervasive 'problematiques' in the socio-technical field and other fields would benefit by being treated at the domain level – or else little reduction can be expected in their turbulence.

*Community-based socio-technical endeavors.* A distinctively American innovation above the level of the single organization has been the appearance of socio-technical projects on a community-wide basis and in a framework of economic and social development (*Trist,* 1977b). The pioneer has been the Jamestown Area Labor-Management Committee created by the unions and management of a small manufacturing town in Western New York State in 1972, when the largest local plant went bankrupt and unemployment rose above 10%. A young and able Mayor, elected with bi-partisan support, succeeded in getting labor and management, who had been in bitter dispute, to cooperate in arresting industrial decline and steering the community toward a viable future.

My own research team began work in Jamestown in 1973. An early study showed that the stock of key in-house skills in the dominant industries – sheet metal work and furniture making – was becoming seriously depleted. These skills were carried by the older workers. There were no systematic training schemes in the small plants

concerned, and many of the young workers were leaving the area. The Committee sponsored a skills development program in which all members could share. They drew on the local community college which had previously had little connection with local industries. Needed courses (for blueprint reading, welding, etc.) were offered on any shift, including hoot owl, in the plants concerned. Some of the most skilled older workers were trained to be instructors.

Next, in-plant labor-management committees were formed in most of the member plants, where we helped to develop programs based on participation and job redesign. By 1976 there were more than 40 such projects (a number of them still ongoing) of 10 different kinds in 12 plants. Most of these plants are job-shops. Worker-management teams have found new ways of winning contracts by bidding lower than the competition. Layouts have been jointly redesigned and product planning jointly undertaken. These activities saved a number of jobs during the recession. Joint sharing of productivity gains has been tried out with some success in plants which had become marginal and seemed too conflict-ridden to survive. While many of the individual projects have had a limited life, others have arisen to take their place – not so much in the same plant as in different plants. These projects have generated 'themes' which have been taken up by various plants, often with no reference back to the research team (*Keidel,* 1978). A community-wide learning process in terms of this 'theme set' has been sustained at the community level over a period of seven years (at the time of this writing) despite 'casualties' at the level of particular organizations. This process cannot be seen if one is working exclusively at the organizational level. Keidel has referred to the coming into existence (through the emerging theme set) of an organizational community between individual organizations and the overall milieu of the city.

As the result of these developments, a major engineering company, Cummins Engines, has been attracted to the town. This will eventually employ 2,000-3,000 people. One or two small companies have followed, and a new hotel has been built in the city center.

Recently attention has been turned to the public sector, where greater job security and higher wages had caused resentment in the industrial sector. Productivity was unacceptably low. Though faced with the difficulties inherent in civil service procedures, labor-management committees are beginning to make headway in one or two departments of the publicly owned electricity plant. The public school system and the local hospital have been successfully included. There are now multiple points of initiative. These become connected. There was a good deal of overlap among key individuals. Active networks were formed.

*Networks.* The study of networks, processes which are fluid and unbounded (as contrasted to bounded and hierarchically arranged

organizational systems), seems to offer one of the most promising ways of increasing our understanding of diffusion processes. During the last two years, my research center at the University of Pennsylvania has been involved in collaborative research into a network-building effort in labor management and work innovation in the public sector in ten American cities (MBSC, 1980). This project is remarkable for the fact that the federal agency concerned (the National Center for Productivity and the Quality of Working Life) did not attempt to develop a central model but sought to elicit the ideas of the periphery and to encourage the various cities to learn from each other. It is also remarkable for the fact that the agency accepted a new methodology of evaluation based on developing the learning capability of the sites through what has been called 'thematic facilitation,' rather than depending on a set of externally contrived, preprogrammed criteria. The research team worked in a participant mode with the sites, repeatedly feeding back material. The most advanced sites have certain common features: they proceed in terms of a programmatic theme as contrasted with single projects with a beginning, a middle, and an end; the overall labor-management steering committee decentralizes responsibility for projects to an evolving set of subcommittees, which draw in an increasing number of people; these committees are empowered to implement – they are not restricted to making recommendations; the overall committee is outward-oriented to the wider organization, whose general policies it seeks to influence; there is no attempt to interfere with the existing adversarial machinery but rather an attempt to build a parallel organization in the collaborative mode. Though this project was undertaken during the period when the Proposition 13 mentality was spreading throughout the country, all the committees have (with whatever vicissitudes) survived. This may be interpreted as a sign that an authentic collaborative process is beginning to emerge in the U.S. public sector. Analysis of the material has led to the first steps being taken towards formulating a theory of 'normative incrementalism' (*Pava*, 1980) as a new strategy for organizational change and 'continuous adaptive planning' under conditions when divergent factions are present.

In Canada, with a number of colleagues, I have become engaged in the nurture of a nationwide socio-technical network with nodes in almost all provinces.

The Canadian project began in terms of the center-periphery model (*Schon*, 1971). Much was learned from the ensuing failure. The then Federal Minister of Labour included QWL in a wider political program of formal tripartism involving management, labor and government. This program was rejected by the Canadian Labour Congress, which vetoed collaboration with government while price controls remained in force, and it was vetoed by the provinces because labor relations, apart from residual federal responsibilities, were a provincial jurisdiction. This attempt at 'instant institutionali-

zation' foundered. The setback provided an opportunity to foster network building in the periphery, and this has accelerated developments in the last three years. Rarely has the policy of a central department been so rapidly and effectively altered.

It may be asked what the criteria may be for assuming that a nationwide process in favor of QWL is underway. In Canada, a number of signs may serve as pointers. The projects undertaken are not only numerous but constitute a series of multiple, independent initiatives. These initiatives are cross-sectoral – representing resource, manufacturing and service industries – and cross-regional; almost all provinces are included. The Ontario government has set up a QWL centre with a joint labour-management advisory committee of prominent individuals. Dr. Hans van Beinum, formerly of the Tavistock Institute, gave up a university chair in Holland to come to Canada to direct it. It now has some ten strategic projects in unionized companies. The business school in the French University in Montreal has taken a lead in stimulating developments in Quebec. Some Canadian projects are of an advanced kind and represent the state of the art in QWL. Some are enduring innovations and have been going on for several years in companies such as Alcan and Steinbergs. In the west, several large companies in the energy industry are seeking to design new installations along socio-technical lines. In the public sector, the Treasury Board has initiated a series of experiments in the federal public service and has reached the point of no longer calling them experiments. At Dr. William Westley's QWL Centre at McGill University, projects have been undertaken in hospitals and schools. Meanwhile, the Federal Department of Labor has held national workshops to identify and develop facilitators, made a set of five documentary films on QWL, arranged a large number of introductory presentations, and published a newsletter. Though these activities have suffered from severe budget cutbacks in Ottawa, they have survived when others have not.

A future research task will be to monitor and analyze such developments to discover what the patterns may be in the early stages of moving towards the new paradigm in a country as a whole, including the nature of the principal obstacles, which in the Canadian scene are still numerous. Further research will also be required to establish which are likely to be the most effective ways of using the electronic technologies of communication now available for purposes of rapid and widespread diffusion to large organizational populations.

This section has touched on a few of the macrosocial processes relevant to socio-technical studies. More attention needs to be paid to the domain level. Complex processes of interorganizational relations are involved, whether in industrial sectors or in communities. Collaboration at this level has not been encouraged by the competitive traditions of industrial societies, moulded as these have been by

the disturbed-reactive environment. Now that the salient environment is becoming that of a turbulent field, a greater emphasis on collaboration is mandatory, and relevant changes need to be fostered in large-scale social systems as well as within organizations.

The oncoming information technologies, especially those concerned with the microprocessor and telecommunication, give immense scope for solving many current problems – if the right value choices can be made.

The field has reached a stage where a new attempt at repunctuation is required. To achieve this, an international conference on 'The Quality of Work Life and the Eighties' is being planned to take place (in Toronto) in the fall of 1981.

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