Characteristics of Socio-Technical Systems [1]

Introduction to the Concept of Socio-Technical Systems

The main methodological questions that will be touched on are the need for

- some system concepts,
- the concept of 'open systems,'
- the concept of **'socio-technical systems'** rather than simply 'social-systems'.

There exist a highly diverse body of scientific concepts and findings about work organizations and the people who operate them. This diversity reflects the many problems that modern industry and commerce present for scientific study. For both practical and scientific purposes it is often necessary to isolate problems such as design of machinery for human convenience, job evaluation, selection, incentive schemes, primary group organization, supervision, and management organization. At the same time, most specialists agree that these problems are interrelated - beyond a certain point the solution of one kind of problem depends upon solving some of the others.

Problems of task performance, supervision,etc., have the character of part problems. Thus, the analysis of the characteristics of enterprise as systems has strategic significance for our understanding of many specific industrial problems. The more we know about these systems, the more we can identify what is relevant to a particular problem and detect problems missed by the conventional framework of problem analysis.

The remains an important question: should an enterprise be construed as a "closed" or an "open" system, ie., relatively closed or open with respect to its external environment?

The "open systems" concept logically implies systems that spontaneously reorganize toward states of greater heterogeneity and complexity and achieve a "steady state" at a level where they can still do work. Enterprises appear to

1 A revision of the original in ***Design of Jobs,*** edited by L. E. Davis and J. C. Talyor. Harmondsworth: Penguin Books, 1972. See also Emery (1959).

possess the characteristics of open systems. They grow by processes of internal elaboration (Herbst, 1954) and often manage to achieve a steady state while doing work, ie., a state in which the enterprise maintains a continuous "throughput" despite numerous external change - what Lewin (1951, ch.9) called "quasi-stationary equilibrium." The appropriateness of the open system concept can be settled, however, only by examining in detail those relations between an enterprise and its external environment that are involved in achieving a steady state. And enterprise exists through regular commerce in products or services with other enterprises, institutions, and persons in its external social environment. The enterprise requires physical supports for its activities - a workplace, materials, tools, and machines - a stable organization of people able and willing to modify the material throughput or provide the requisite services.

An enterprise responds to the joint action of its immediate material and human resources and to a broader social environment. The form of wider environment influence illustrated here pertains to its effects upon the ends of the enterprise. By changing the conditions of an enterprise's commerce, the environmental factors also change the ends it can pursue and make pursuit of the other ends inimical to its survival. Thus, just as the immediate means and resources limit the sorts of commerce in which an enterprise can engage, so the wider factors impose new ends and changes in the enterprise's means and resources.

A characteristic of open systems is that, while in constant commerce with the environment, they are also *selective and, within limits, self-regulating.*

The *technological component,* in converting inputs and outputs, plays a major role in determining the self-regulating properties of the enterprise. It functions as a major boundary condition 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 make up the technological component is usually defined as "belonging" to an enterprise. They represent, as it were, an "internal environment."

Thus, it is not possible to define the conditions under which an open system achieves a steady state unless the "system constants" include mediating boundary conditions (cf. von Bertalanffy, 1950). The technological componenet has been found to play this mediating role. It follows that the open system concept, as applied to enterprises, ought to be referred to the socio-technical system, not simply to the social system.

Williams (1950) suggests that, at this level of generality, one should distinguish economic as well as social and technological systems; and also that "it might be convenient to define a political system." (p.9) This suggestion

confuses concrete referents with analytical abstraction. An enterprise is a body of people and material means; analytically, one should abstract, from the concrete social relations existing between these things, aspects concerning allocation of limited resources for consumption or production, power and responsibility, etc. The first step in studying and enterprise is, however, to identify the characteristics of its substantive components. After this, one may fruitfully study the economic and political aspects.

It might be justifiable to exclude the technological component from the system component if it played only a passive and intermittent role. However, it cannot be dismissed as simply a set of limits that influence an enterprise only in its initial stages and when it oversteps its limits. There is almost constant accommodation of changes in the external environment, and the technological componenet not only sets limits upon what can be done but also creates demands that must be reflected in the internal organization and ends of an enterprise.

However, an enterprise can pursue other strategies the exploit the lesser, but still real, dependence of the environment upon the enterprise. Although dependence of an enterprise of its external environment is usually the most striking aspect, there is, inevitably, some interdependence. An enterprise can select from among the range of personnel, resources and technologies offered by its external environment and can develop new markets or transform old ones.

Because the enterprise is an open system, its management "manages" both an internal system and external environment. To regard an enterprise as closed and to concentrate on management of the "internal systems" would be to expose it to the full impact of the vagaries of the broader environment.

The Main Features of An Enterprise as a SOCIO-TECHNICAL SYSTEM

The first function of a socio-technical systems concept is as a frame of reference - a general way of ordering the facts. It directs attention to the following groups of problems as the focus of three main stages in the analysis of the enterprise:-

- The analysis of the component parts to reveal the way each contributes to the performance of the enterprise and creates or meets the requirements of other parts. The first components to analyze are 1) the technical and 2) the "work relationship structure" and its occupational roles.

- The analysis of the interrelation of these parts with particular reference to the problems of internal coordination and control thus created.

- The detection and analysis of the relevant external environment of the enterprise and the way the enterprise manages its relation to it.

The same frame of reference may well be applied to the study of parts of an enterprise. For primary work groups, the relevant environment is provided by the enterprise itself, since it defines the ends of these groups, controls the input of people and materials and constantly influences group performance. Analysis of parts of an enterprise also involves attention to details usually disregarded in analysis of the enterprise as a whole. To analyze structure, "no more is required than the whole from which the analysis starts and two levels of analysis" (Feibleman & Friend, 1945:42). In the study of a part-system, the roles and the interpersonal action constitute the two required levels of analysis. Both levels require decision taking - deciding overall objectives for the set of roles and deciding who should perform which roles at a given time.

In its second function, the concept of socio-technical systems invoke a body of subordinate concepts and hypotheses to describe and explain the behavior of enterprises and their members. This function is strictly derived from the first. There is no single body of concepts that can claim to be *the* theory of socio-technical systems. Concepts in use range from highly abstract ones drawn from general systems theory to descriptive ones, such as task interdependence and the primary work group.

THE TECHNOLOGICAL COMPONENT

Trist and Bamforth (1951:5), in the first public usage of the concept of "socio-technical systems", made the common distinction between the "technological system" and the "social structure consisting of the occupation roles that have been insitutionalized in its use." The next step in the social scientific analysis is usually to seize upon some isolated aspects of the technological system, such as repetitive work, the coerciveness of the conveyor belt or the piecemeal tasks, and to relate these to the observed social life of the work group. Even a detailed study of the technology has not been treated as a basis for this next step but has be relegated, as in Warner & Low (1947), to an appendix. The same error occurs on the social side.

> It has been fashionable of late, particularly in the humans relations school, to assume that the actual job, its technology and its mechanical and physical requirements, are relatively unimportant compared to the social and psychological situation of men at work. (Druker, 1952)

The Trist & Bamforth study broke with this tradition by treating the problem as one of relating two *systems,* both part of a more inclusive system:

> So close is the relationship between the various aspects that the social and the psychological can be understood only in terms of the detailed engineering facts and of the way the technological system as a whole behaves in the environment of the underground (mining) situation. (Trist & Bamforth, 19851:11)

They introduced a number of concepts to depict the interaction of the two systems and those characteristics of technological systems that are most relevant to the social system. To do that requires a detailed knowledge of the technological system and the descriptive terms used by engineers and operators. It results, however, in describing technology in significantly different terms from those used by engineers and operators. A social scientist description of the technological system intimately portrays its demands on the social system, whereas an engineer describes what the machines, apparatus and materials require of each other for efficient coordinated operation.

At this point, the distinction may be made between purely technical requirements - e.g., the conveyor speeds required to feed particular machine at optimum rate - and those that arise because machines cannot produce without human intervention. Both have to be taken into account by an enterprise, but the former is usually the province of only engineers. On the human side, there is an overlap in the professional interests of engineers and social scientists in the field of "human engineering' - the design of machines and their coordinate tasks for optimum fit between them and the skills of human operators. Beyond this are problems of relating technological requirements to people as purposeful beings, not simply as another kind of machine, and to groups of people, not simply to isolated individuals. It is these latter problems which will be considered here.

It is useful to identify the main technological dimensions that affect social systems. These can guide the analysis of a given technology and enable comparison of it with others. The following list includes those dimensions singled out by Tavistock researchers and also makes explicit others that have been implicit until now. The list is not exhaustive.

The natural characteristic of the material being worked upon insofar as it limits, assists or introduces uncontrolled variation into the labor requirements of the production process, for example, in coal mining where the hardness and 'grain' of the coal exert considerable influence on the strain experienced by individuals, work groups and management. Rice (1958; 1953/Vol II) has indicated how the variation in tensile strength of cotton creates social and psychological problems in textile mills. The nature of the material may underlie such broad differences as those between agriculture and industry or, within industry, between process and fabrication. As with each dimension listed here, it is not possible to argue directly from these facts to the operators' behavior - how they will respond depends also upon other factors.

The level of mechanization (or automation). This dimension has been rightly considered the most important. Historically, changes in the degree of mechanization have been more frequent and have shown a singleness of direction and a logic not apparent in the changes that occur in the other dimensions. Changes

in mechanization level will frequently effect changes in the other dimensions. A more powerful machine, for example, makes the difference in hardness of coal less relevant, or the flexibility of a high speed spinning machine makes more necessary the uniformity of the cotton.

Degree of mechanization determines the relative contributions of machines and men to the production process, and the direction of development is to lessen the human contribution. More detailed criteria are needed to judge differences in mechanization among technological systems or even among parts of a single system. These criteria are now receiving attention in connection with what has been called "automation".

While the term automation has been used in a number of ways, all users seem to have in mind an ideal concept of a fully automatic factory or office. Thus, all technical developments in this direction and an emerging philosophy of management, production and design have tended to be gathered under the title automation (Bright, 1955) We need to treat technical change as an independent variable if we are to trace its social and psychological effects on production systems. The term automation is thus restricted to *"the use of devices - mechanical, pneumatic, hydraulic, electrical and electronic - for making automatic decisions and efforts."*[2] So defined, automation includes, what is commonly regarded as mechanization, i.e., "the use of mechanical techniques for performing automatic efforts, usually with pneumatic and hydraulic elements." This definition still does not clarify the concept. We need to specify at what point the term "automation" is warranted.

At a certain level of mechanizing a production system, there occurs a "re-centering" of attention from the manual operator to the machine, from man-hours to machine hours. "The provision of and maintenance of conditions which best allow the machine to operate and to continue operating, become the goal of the system." (Trist, 1953) It is only when the efficiency criterion of machine utilization replaces that of man-hours that it seems useful to refer to the ideal end point of full automation rather than, as with the term mechanization, to make comparison with the beginning point of manufacture. In the scale in Table I, developed from (Bright, 1955) and (Amber & Amber, 1956), the "watershed" may be placed between levels 2 and 3. Much finer distinctions are possible than are made in the scale, and, as Bright has shown, are required to represent those higher levels of automation in which more and more of the calculation (conceptual skills) is embodied in the machine. Computers enable levels of calculation not economically feasible with human operators, even if humanly possible.

2 This is the definition of AUTOMATION that is given editorially in Emery (1957)

TABLE I Types of Human Activity Replaced by Machines at Different Technical Levels

Level	Power (gross motor action): For basic function	Power (gross motor action): For auxiliary function	Control: Fine motor action for guidance & positioning	Control: Perceptual *skill* (monitoring)	Control: Conceptual *skill* (calculating)	Control characteristics	Examples
0	—	—	—	—	—	—	hand tools
1	X	—	—	—	—	—	portable electric tools
2	X	X	—	—	—	—	bench lathes, power shovels
3	X	X	X	—	—	"open loop"	transfer machines
4	X	X	X	X	—	"closed loop" (pre-set limits)	chemical process plants
5	X	X	X	X	X	"closed loop" (variable limits)	computer-aided machies

While the general format is that of describing successive stages in replacing human labor and skills, it needs to be bome in mind that automation does more than this; it makes possible things that are not within human potentiality and would necessitate the introduction of further dimensions to represent higher levels-in particular the levels of computer functioning.

The unit operations required to complete the changes involved in production and the natural grouping of these units into *production phases* (as in the construction of a process chart by production engineers). The patterns of phases may be changed by changes in the machines or natural conditions, for example, the way multi-jib cutters eliminated blasting operations in coal mining, the effects of continuous casting in foundries and of the replacement of pressing by metal cutting in machine shops. A change from mechanical to hydraulic mining would produce even more drastic operations changes. New processes such as power molding, extrusion and electric spark machining point to an important dimension of technological changes different from mechanization.

In some respects, this dimension reflects natural forces brought under human control by the expansion of scientific knowledge beyond mechanics and hydraulics into atomic and molecular physics, organic chemistry and bio-chemistry. In many new industrial processes no underlying similarity exists between machines and the worker-as-a-machine. New processes represent qualitatively new forces for production, and entail new demands for certain kinds of labor and coordination. The emergence of laboratories and work roles for scientifically trained personnel changes labor requirements and creates new problems of coordination. The new processes blur the distinction between "unit operations" and "phases", as operatives tend to be engaged not with the units of a phase but with controlling the conditions (e.g., temperature, acidity,

pressure or flow) that permit the natural processes themselves to carry through the whole phase of the work. As these conditions are closely interdependent, operatives' work must be closely coordinated and there is not the same possibility for externalizing the coordination as exists when responsibility can be allocated for each of a number of separate unit operations.

The degree of centrality of the different production operations. It is also possible to distinguish differences in the degree to which various production processes command special attention, special effort or special skill. Thus in machining metal, it may be that only removing the final few thousandths of an inch requires high level skills; in coal mining the filling operations will have a greater effect on the total process than will, for instance, speed and skill in shifting the gear head.

These activities are, by implicit definition, necessary to the productive process. But, from the point of view of the performance of the whole productive system (which includes the operators, etc.), it makes a considerable difference whether the organization of operative and supervisory roles reflects the centrality of key processes. A further distinction may sometimes be required between *necessary* but irregular and infrequent operations and *optional* ("ancillary" or "external") operations. These latter are not strictly necessary to a productive system's performance but still serve some real or presumed function.

The maintenance operations needed to maintain conditions required by the productive process. These "boundary conditions" of production concern some of the points at which the productive process interacts with, and is influenced by, the internal material environment, and they help protect the process from disruption or unpredictable fluctuation due to the latter. Such activities include repair and maintenance. The relation to productive operations varies with differences in each dimension listed above and requires different roles and work relationship structures.

At low levels of mechanization, it may be tolerable to have a considerable social and organizational gap between production and maintenance workers. Skilled maintenance workers frequently life a life apart from the others and have a great deal of influence on the determination of maintenance priorities. However, with higher mechanization, the greater internal differentiation and rate of production of the technology make it much more sensitive to changes in its boundary conditions and impose heavier demands on maintenance. Reorganization of maintenance to meet these demands is influenced by two general requirements:

- Preventive maintenance to promote continuity of running and prevent faults and breakdowns in the machines.

- When breakdowns do occur, to keep loss of machine time down to a minimum (Trist, 1953)

Production roles have been redefined to include responsibility for some running maintenance and initial diagnosis of machine breakdowns (cf. Trist, 1953 and Rice, 1958, for examples in mining and textile manufacture, respectively), and the performance of these roles has been strengthened by the introduction of "drills" (cf. Trist, 1953). In addition, maintenance organizations have been elaborated into sections responsible for on-the-spot repair, repair-without-replacement, repair-with-replacement, etc., to maximize machine utilization while keeping replacement costs within an economic limit.

Supply operations also set major boundary conditions for production as they seek to maintain a planned production rate despite unplanned variations in the import and export of materials from and to the external environment. They differ from maintenance both in their tasks and in the source of variability that they seek to offset. They are less difficult to coordinate with productive operations but, because of their externally directed activities, are more difficult to coordinate with the overall purpose of the enterprise. Thus, they frequently create demands that have to be handled at the managerial level of the social system.

Dependent in the first instance on the demands of the productive operations and the external environment, these supply operations in turn create specific demands on the social system for personnel and coordination. Like maintenance, the supply operations become more critical to efficient performance as mechanization increases. The greater rate of throughput raises the cost of stoppages due to failure of supplies and requires more effort to hold stocks within economic limits. These factors create a mechanized and automated supply technology commensurate with the new production technology (cf. recent "Just in Time" methods).

The spatiotemporal dimension of the production process. The spatial layout and the spread of the process over time (operations carried out simultaneously or sequentially, on one shift or across several shifts) influence coordination, mutual support and interpersonal contact. The spatiotemporal distribution of machines and of operatives tends to influence the ease with which interdependent activities are coordinated, supplied and maintained. It creates a specific human ecology by throwing some people together and separating others. Lombard (1955) shows that this interdependent effect of spatial location arises from a tendency of workers to value a stable territory and to interact more with those nearest to them.

These aspects of a technological system can sometimes be varied independently. Thus, although the Bolsover "handfilled" longwall mining system

differed from the conventional longwall system only in its spatial scale, it made possible a great different "work relationship structure" and different occupational roles (Wilson et al., 1951). The temporal dimension changed as a result of the spatial change and, with the introduction of a continuous mining machine into the Bolsover system, the spatial dimension remained constant but the temporal dimension underwent great change and led to the emergence of a new set of requirements (Trist, 1953).

In analyzing the spatial and temporal dimensions, we need to consider the extent to which they make a real difference to communication and other social processes involved in operating the technology. Thus, the spatiotemporal concentration of production that occurs with increased mechanization and automation does not lead consistently to closer contact among operatives because there is often a thinning-out of labor, growth in the physical size of the plant and more multi-shift working. While a number of important generalizations can be made about the effects of the spatiotemporal dimension (Miller, 1959/Vol lI), these are usually complicated by the demands for cooperation that arise from the other dimension of the technology.

The immediate physical work setting. Many of the immediate conditions of temperature, light, noise, dust and dirt are broadly dependent upon the nature of the material and the level of mechanization. Certain working conditions are regarded as characteristics of foundries, ironworks, cotton mills, machine shops and mining. It is desirable to consider physical setting as a separate dimension because these conditions are, within broad limits, capable of considerable variation, and because they are related differently to the social system. As Walker (1957) has shown in his study of the Lorain tube Mills, local variations in physical conditions may cause strife in the social system if "bad' conditions are attributed to managerial indifference. The classic Hawthorne study showed that the major effect of changing physical conditions may be that of convincing workers of management's concern for their welfare. In both cases, it is the relative interdependence of the work setting from other technological dimensions that underlies this influence on the social system.

The relative importance of these dimensions will vary with the purposes and objects of study. Unless these dimensions are considered, we cannot exclude the possibility that observed roles and role relations are a response to some undetected technological requirements.

Failure to consider these facts make it difficult to access the validity of many social scientific findings in this field, including many of the effects of "automation". In ignoring the technological variable, we run the risk of attributing casual effects to factors that are merely concomitant (cf. a case of "spurious correlation".).

An analysis in these terms can a yield a systematic picture of the human tasks and task interrelations required by a technological system. However, between these requirements and the social system there is not a strict one-to-one relation, but what is logically referred to as a correlative relation (cf. Feibleman & Friedn, 1945, who observe that this is what one would expect to find between two separate systems or processes).

In a simple operation such as manually moving and stacking railway sleepers (ties) there may be only one single suitable work relationship structure, amely a cooperating pair, each worker taking an end of the sleeper and lifting, supporting, walking and throwing in close coordination with the other. The ordinary production process is much more complex, and it is unusual to find only one particular work relationship structure that can be fitted to thses tasks.

Some technological features that increase the indeterminacy of the relation are:

- The variability in size of the tasks. They are not all one man-shift size.

- The spatial separation that often makes it difficult to group together interdependent tasks that ought to be brought together. The need to avoid lost time and effort in travel may dictate the grouping of unrelated tasks or concentration on tasks that are very similar.

- The simultaneity or temporal separation of tasks may likewise suggest, or even necessitate, different groupings of tasks from those indicated by task similarities and dependencies.

From the social system arise other equally potent influences. These may dictate quite different groupings of tasks to meet the real or presumed requirements of the social system

Allowing for the "openness" of the relation between tasks and sets of roles, there is still a great deal to be gained from developing concepts that describe the dfferent forms of task relations.

In the Tavistock Institute studies, there have occurred a number of such concepts (Herbst, 1959; 1976/Vol II). The simplest conceptual distinction is between dependent and independent individual tasks. Independent tasks, by definition, do not require cooperation between qorkers, unless:

- They are dependent with respect to the supporting activities or conditions that they require

- They are dependent with respect to some "end-conditon" or goal.

These two cases permit considerable freedom of choice between different forms of work structure. Roles may organized so that works are unconcerned with the end result (defined as someone else's responsibility), so that they are competitive; or they create a group collectively concerned with the end results. Such groups have been found, experimentally, to yield positive effects on performance and morale (deutsch, 1949; Coch & french, 1948; Lawrence & Smith, 1955). Rather less freedom exists in the case of "dependence with respect to supports". There are dangers in having workers compete for things they need in order to carry out their task. the devices by which they secure these things may deprive others of "fair" access. On the other hand, a choice can be made between providing these things separately to each worker, which stregthens the supervisor's hand, or making a group of workers jointly responsible for results.

There are two kinds of dependent tasks. *Simultaneous interdependence* is characteristic of a task too large for and individual to perform in the required time and hence broken down into individual part-tasks. At one extreme, is "simple interdependence" in which similar part- tasks have to be performed together if they are to be effective. At the other extreme is "complex simultaneous interdependence" in which the essential factor is the presence of different and complemenary actions executed simultaneously and with reference to each other (Asch, 1952:175). These systems of complex cooperation have the fundamental purpose of accomplishing a given task within a concentrated period of time. In composite mining systems, this form of cooperation has the important effect of guaranteeing continuity in the face of individual failure - a reliably performing group despite the failure of some inidividuals to come up to the mark.

Successional dependence is the most widespread form of task interdependence. It occurs in two main forms: the task may be such that, as in longwall coal-mining, only one set of operations can be carried out on each shift; or successive operations can be performed simultaneously, as on an assembly line. This difference affects coordination and group formation but not the classification of formsw of dependency. The following appear to be the possible form:

cyclic abc, abc, etc. A chain of tasks is normally only a section of a cycle.

convergent a & b to c
divergent a to b & c

There is also a *part/whole* interdependence when an individual task is a minor part of a whole task for which another individual is responsible (e.g., the relation between the manual plugger and the operator of the piercer machine in

the Lorain Tube Mill [Walker, 19571).

There are many more possibilities. Task relations can vary in the reciprocity or nonreciprocity of dependence, direction of dependence and degree of dependence, which is partly determined by the time lag between the end of one task and the beginning of the next. In some cases there may be very little variation possible; in others a great deal. Automated production lines frequently allow little variation, and some form of "buffer" supplies have to be inserted to reduce the degree of dependence. Tasks may also be dependent upon the quality of work done in preceding tasks. This dependency may be lessened by inserting special inspection/ rejection roles or devices.

A chain of sequential dependent tasks may be influenced by the location of the "pacesetters." Thus, in automated Tube Mills (cf. Walker, 1957) there is a chain of tasks, each dependent upon the preceding one for its supply of prepared materials. The pacesetter tends to be one of the middle tasks. This shifts dependencies so that previous tasks become interdependent and following tasks more dependent.

Another important feature is that in less rigidly dependent task structures (e.g., composite mining systems), role relations vary depending upon the need to lessen unnecessary travel (of workers or materials) and the "dead time" of waiting for the next task.

WORK RELATIONSHIP STRUCTURES AND OCCUPATIONAL ROLES

Trist and Bamforth (1951:9) have postulated that the demands created by a technological system are met first by "bringing into existence a work relationship structure. " This structure is related to tasks and task-interdependencies that, together with the machines and apparatus, constitute the component operations cycle required by the productive process under its particular conditions of mechanization, spatiotemporal scale, immediate environment, etc. A key concept, occupational role, served to identify the individual's location within the work relationship structure and in relation to the production process:

> Occupational roles express the relationship between a production process and the social organization of the group. In one direction they are related to tasks which are related to each other; in the other, to people who are also related to each other. (Trist and Bamforth, 195 I: I 4)

The role concept alone does not explain how individuals will experience tasks, nor does it explain the various interdependencies between tasks and between workers.

The concept of role does, however, lead one to expect workers to experience tasks not in isolation but as roles that generate a sense of dependency, subordination, self-worth, trust, isolation, etc. Thus, although individuals may find immediate tasks distasteful (probably most typical for operators in modem industry), they may gain compensatory satisfaction from other role aspects that concern relations with fellow workers, supervisors and the enterprise. Where the components of a role form a "weak gestalt," however, there would be more likelihood of "compensation" than where these components form a "strong gestalt." This problem can be explored further only through the second aspect of the role concept.

This aspect suggests that at the next level, task interdependencies are co-related primarily to role relationships rather than to interpersonal relations, i.e., social relations formed to cope with task demands rather than informal social relations serving individual ends.

E. Gross (1956) has aptly described the underlying processes as those of *symbiosis and consensus* respectively. The distinction draws attention to a further distinction among formally defined symbiotic role structure, informal symbiotic relations and informal consensual relations. In the informal symbiotic relations, the individuals remain oriented to the institutional goals, but in the consensual relations individuals are (according to our use of the terms) oriented toward personal goals that are not adequately catered for, or may even be threatened, by the formal organizational goals. These primary groups on a consensual basis will be functional to the extent that they save the organization the trouble of catering for these personal feelings and interests and prevent more extreme individual solutions of absenteeism and accidents (in military organizations these groups appear to lessen the chances of desertion and self-wounding). They will be dysfunctional if they can pursue their interests only at the expense of the organizational goals for, in this case, they will be more able to resist organizational pressures than they would be as isolated individuals (Collins et al., 1946; Roy, 1952, 1954; Dalton, 1948).

The formal and informal symbiotic ties may be regarded as two aspects of the role structure. "Informality" here implies that the traditions or sanctions are carried by peers and not explicitly recognized by management.

From the above discussion, it is clear that there is an acute problem in trying to "map" the task structure with a formal role structure. Reliance on informal mapping, even if immediately effective, reduces the control of the enterprise leadership and makes it more difficult for them to meet wider challenges. The evidence suggests that formal recognition of group responsibility may close the gap between the definition of roles and the wide range of task interdependencies that exist. A difficulty remains, however, in detecting within the total task

structure a genuine basis for such groups.

The mapping problem is simplified by the recognition that there may often be groupings of production tasks that have "whole" characteristics. A qualitatively different relation of tasks and roles emerges when a set of *connected roles* is grouped around a whole task. This allows a closer coordination of role and task interdependencies than where these are mediated by the overall tasks alone. These connected sets of roles show greater autonomy and are less dependent upon external supervision and coordination (cf. Trist and Bamforth, 1951, on the longwall ripping team, and Rice, 1958, on the reorganized weaving teams). Individuals experience through group membership the satisfaction of completing a whole task that is denied them in doing individual tasks (Wilson et al., 1951, Par. 38, give experimental evidence of this effect).

> *A group consisting of the smallest number that can perform a "whole" task and can satisfy the social and psychological needs of its members is, alikefrom the point of view of task performance and of those performing it, the most satisfactory and efficient group. (Rice, 1958:36)*

We can assume that this phenomenon operates through the psychological identification of the individual with the other persons in the group rather than through the role definition of an individual's task as part of the whole task. Thus Rice (1958) discusses the optimum size of the group in terms of clinical experience (P.37) and Wilson et al. (1951:46) express surprise when they find this phenomenon in a group of 19:

> We had thought that a group of 19 might be rather large, but experience of relations on the face has considerably reassured us on this point. (par. 46)

In a later mining study, this phenomenon was observed in a primary work group of over 40 members.

This question of group size has plagued attempts to analyze the relation between task and work relationship structures. I think it shows the extent to which the new notions of work groups remain entangled with the recent "human relations" concept. The assumption that "friendliness" is the critical factor in group cohesiveness has been at the center of the semi-ideological human relations movement. The implicit structure of the argument can be illustrated as shown in Figure I.

The friendship theory of work relations rests on three propositions:

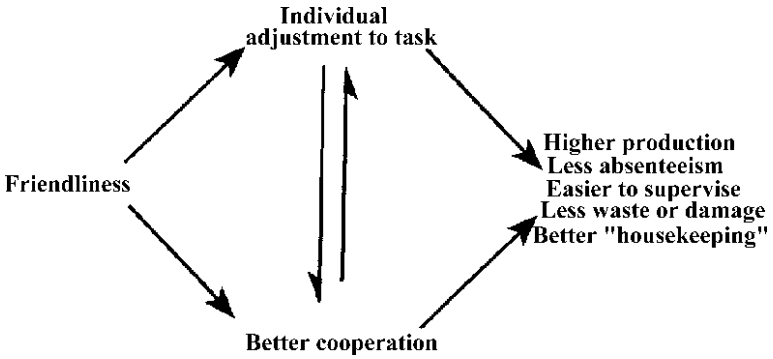

Figure I . The premises of the human relations movement

- Friendliness on the job leads to better individual adjustment to the task.
- Friendliness leads to greater willingness to help.
- Interaction leads to greater "knowledge of others" and hence to more effective cooperation.

Our present concern is with the last two propositions. Jasinski's (1956) study of assembly-line groups provides a useful test in that the objective requirements for interdependence are very low. His study showed that workers who are adjusted to their task do not care whether or not they can talk to their fellow workers. However, among those not so task-oriented, the best adjusted are those who have friendly relations with other workers. Unfortunately, there is no indication of the strength of these friendships (whether, for instance, they Carly over into private life). A more dramatic qualification is that friendships on the job may, in the absence of task orientation or organizational commitment, substantially increase the difficulty of enforcing task performance (cf. Roy, 1954).

In terms of the second proposition, the desirable work relationship structure could be achieved by:

- Organizing the workers into small groups. A large group inhibits stable interaction patterns. "With more than 12, the complexities of the multiple relationships to be maintained become too great to be carried by every member, and the group tends to be split into sub-groups" (Rice, 1958:37). Groups of six to 12 increase the possibilities of interaction and allow for group identification to develop and a heightened sense of belongingness.
- Increasing the likelihood of friendship by some sociometric self-selection of the group or, if this is not possible, selecting as group members those who are most similar to each other on the grounds that interaction between similars leads more quickly to friendliness.

These measures have not been uniformly successful. There exist stable, effective groups too large for their behavior to be explained on these grounds. Extended investigation suggests that insofar as workers accept their work role,

i.e., are task oriented, they prefer to work with others who are "psychologically distant" and "task-centered" (Fiedler, 1953).

What is required are relations in which workers see their task performances as mutually supporting. Supportive relations are not equivalent to, nor dependent upon, friendship and would tend to be disrupted by interpersonal hostility or intensive friendships. Several important facts point to the significance of "mutual support" in productive relations:

> An individual may not be willing to accept a task in the absence Of support, even though able to perform it. (Marshall, I 947; Hughes, 1946)

If support is seen as coming, at least in part, from the group with whom the workers' tasks make them interdependent, then they will tend to value the group, to accept the group task in part as their own; as a corollary, they wish to be persons of significance for the group and to have their task performance accepted as a significant contribution to the group task.

No doubt some friendliness will develop under these circumstances, constrained by the task requirements and essentially a by-product Of group formation, not in itself crucial for enhanced performances. From this viewpoint, friendship might occur with high performance even though it is not causally related to the latter, and one would expect to find it constrained to on-the-job relations.

It appears that support ought to be built into the organization of roles if task performnance demands it-that with interdependent tasks the roles be so defined as to enhance mutual support and the task be so organized and rewarded as to facilitate identification of part-tasks with the whole.

Conversely, if tasks are interdependent and yet for managerial' reasons group formation is not desired, then support must come from sources other than those sharing tasks and the rewards and penalties have to be related to performance of the part-tasks.

The interaction hypothesis (not to be confused with the interaction/ friendship hypothesis) has undergone similar modification. Knowledge of others is not consistently found to be related to effective perfort-nance (Fiedler, 1953; Steiner, 1955). Only that knowledge is required that is relevant to the cooperative perfortnance of the group task. in a stable socio-technical system, this knowledge tends to be incorporated into the role system. Knowledge of the role system informs each individual of what can be expected of whom and when.

> It is the advantage of role systems that behavior synthesis has been incorporated into the system itself, and that participants need not infer the strategies of their associates or improvise an effective synthesis as they engage in collective action.

> They need only to produce the behaviors which are situationally appropriate for members of their category. (Steiner, 1955:272)

The formal definition of a role system only encompasses one part of the role content. Every role system tends over time to accumulate and synthesize a wealth of knowledge about the role behaviors for various contingencies, whether from variations in the group task, the personalities entering the system or the system's environment. This important aspect is supported by the parallel emergence of role *standards* that enable members of a role system to classify variations from the "normal," based on what is relevant to the group's task performance rather than personal determinants (cf. Collins et al., 1946; Roy, 1952; 1954).

This suggests that the key interaction for a group is of a kind which permits development of a role culture and mutual testing out of the role-bearers (hence the significance of "drills" in breaking in a new ship crew). The same persons need not be kept in continuous interaction. Considerable role rotation is possible. In fact, knowledge of the role system is more likely to follow from rotation; harmful distortions can result from viewing a role system from just one position.

THE ENTERPRISE AS AN INTERNALLY DIFFERENTIATED ENTITY

In a mining system, the method of face work is the independent variable. Once this is changed, everything else has to come into line until a new internally self-consistent structure emerges which affects everything from the face to the surface (Wilson et al., 1951, par. 54).

In the coal-mining and textile studies, only a part of the enterprise was studied, and the work structures could be changed by executive action. Both studies insisted that changes in the work structure would set up forces toward change in the rest of the social system and, conversely, that the effects of changes in the social system would depend in part upon the character of the existing work structure.

Trist and Wilson traced this dynamic relation through the concepts of *coordination and control*. Required by all production systems, these become key "executive functions" of the management. Coordination and coercion come into sharp focus in the role of supervisor or foreman. Some of the supervisor's problems can be brought out by considering the effects of the different demands on the operatives in "isolated" work roles and in groups with a whole task.

So long as work roles center on isolated tasks, special roles are required to

coordinate the different tasks. The more unpredictable the variation in the task/labor coordination and the greater the interdependence of the task phases, the greater the need for coordination. Conflicting production demands require, n addition, some form of scheduling.

Coordination may be provided by special supervisory roles and in part by the creation of primary work groups. The occupant of a special supervisory role is dependent upon all workers "doing their bit" for coordination of different tasks to be effective. Yet the supervisor can only influence a worker's behavior by threat of sanctions or promise of reward. Supervisors would be overwhelmed by work and anxiety if they tried to do each task whenever anything went wrong. Any unpredictable variation-changes in task orientation of workers, a move from male to female operatives, even decline in quality of raw materials-could increase the demand for external supervision and the use of coercive sanctions.

In this particular relation of worker to supervisor the "alienated" character of modern labor becomes most obvious. Management delegates the quality and rate of work to the supervisor, who entices or cajoles the worker into "accepting" a share of the responsibility. The "coercion" is unavoidable. Yet, without detailed controls, rewards and punishments, it undermines the operative's willingness to work. This is the classic dilemma of autocratic control, justified on the ground that within the supervisor/ worker relation "persuasion or social influence to work harder would produce more work. In fact, this does not happen" (Argyle et al., 1958:36).

On the other hand, supervisors might minimize coercion and the consequent disruption of the task. The most important techniques are not those that manipulate personal relations with the workers, which would likely result in collusion to avoid their role obligations (Roy, 1954) or in undermining faith in the enterprise as promises remain unfulfilled.

Nevertheless, this "human relations" approach frequently appears in training courses for supervisors in industry, the an-ned services and other occupational fields (cf. National Institute of Industrial Psychology [NIIP], I951; Zaleznik, 1951). It assumes "that job satisfaction and output are positively related. Not only is this not generally the case, but in some studies they have been found to be negatively related" (Argyle et al., 1958: 36). Appropriate supervisory actions seek to lessen the strain operatives experience in doing their tasks (cf. Lewin, 195I:202-7). Supervisors may lessen irritating "resistances in task-performance by providing 'know-how,' adequate maintenance and other support, and may spread the strain more evenly by programming work to match differences in machines and operatives." Such actions increase the control that individuals have over their tasks. Interactions with the super-visor are more likely to be in response to operator needs than supervisor's

anxieties, and operators will see supervisors as more concerned with their needs. (Walker et al., 1956, gave much the same picture in their study of assembly-line foremen.)

Coordination may be more effective if work roles are embedded in a primary work group with its corresponding group task (cf. Trist, 1953, par. 69-73). By allowing a degree of self-government to such groups, first-level supervisors can focus on coordinating tasks between groups and with various service groups. Supervisors would be less concerned with wielding sanctions under these conditions. When internal group sanctions are inadequate, the matter would normally concern a level of management above the supervisor. The supervisory role would, however, require higher conceptual skills. Self-managed groups are more complex to supervise than individual roles. They do more over space and time that cannot be overseen directly, requiring a conceptual representation of what is going on. Effective supervision would entail planning further ahead so that the groups receive sufficient support and servicing to keep going. This orientation of first-level supervisors toward coordination is similar to that of upper management and less preoccupied with controlling the individual/task relation that is a prerequisite of functional supervision (cf. NIIP, 1951:2730). As a general proposition, *the primary task of the supervisor is to manage the immediate boundary conditions of the worker/task relation* and thus effectively relate them to the larger organizational structures.

It should also be clear that an enterprise is not completely free to choose between isolated and group organization of tasks:

> The degree to which a work group is capable of responsible autonomy is a function of the extent to which its work task is itself autonomous in the sense of being an independent and self-completing whole. (Wilson et al., 1951, par. 22)

The definition of group powers, and hence the delegation of responsibility, is easier to achieve when "tasks performed by individuals and groups can be performed within definable physical boundaries. Those responsible for the task can then 'own' their 'territory.' They can easily identify what is theirs and who belongs in it. They can raise questions about the right of others, not engaged on the task, to be there" (Rice, 1958:35; Miller, 1959/Vol. 11)

There are other limits too-the kinds of persons in the group, and the group's ability to control the task and to take responsibility. If these conditions are not present, merely dictating that such-and-such operatives shall constitute a group would not make any difference to the supervisory requirements.

The effects of high mechanization and automation on supervision will vary with the requirements for coordination and the possibilities for "positive" supervisory practices that these technologies create. Regarding the different forms of high mechanization, it is only possible to make limited generaliza-

tions. Their common characteristics suggest that a higher level of coordination will be required to offset the greater rate of production, the greater potential loss of production and cost of damage due to errors. These conditions, plus the “sensitive" nature of the individual operative's contribution, make it even more necessary to reduce any feeling of coercion. This is obviously so for operatives employing conceptual skills who are responsible for relatively complex judgments and decisions.

The Psychological Requirements of the Individual

The preceding outline of socio-technical theory revealed several weak points-matters that are given empirical attention but that have not been developed theoretically beyond a few isolated hypotheses:

- The burdens, satisfactions and individual experiences in carrying out various tasks, including the problem of "alienation."
- The "recalcitrance" of individuals and social groups in the face of the overall requirements of the enterprise (particularly as it creates control mechanisms based on coercion and manipulation).
- The emergence within an enterprise of purposes other than those expressed in, or supportive of, its goals.

The immediate impression is that these are all "dysfunctional" aspects of enterprise life, and hence that the theory is a species of "managerial sociology" (Friedman, 1955). However, there are reasons for regarding this as a superficial explanation-as noted above, these matters are given empirical attention in the studies of the Tavistock Institute of Human Relations and of the other "system theorists." The lack of theoretical development seems consistent with a justifiable emphasis upon first clarifying the requirements of socio-technical systems up to, and including, whole enterprises. At the level of analyzing individual enterprises, the conditions basically contributing to the above phenomena must be regarded as "givens"; they are rooted in the broader human, social, cultural and economic context of the enterprise. Theoretically, they present the same sort of problem that Chein (1954) raises in his study of environmental determinants of individual behavior; i.e., these are systematically conditioned by facts lying outside the immediately relevant frame of reference. Thus, while it is correct to say that failure to consider these environmental encroachments will lead to certain kinds of errors (Wilensky, 1957), it would be incorrect to damn socio-technical or related system theories for their failure theoretically to encompass such problems. What this criticism does validly entail is that socio-technical analysis must draw heavily upon other areas of social science, as we found necessary in clarifying what was "human relations" and what was "autonomous group functioning."

THE INDIVIDUAL AND THE TASK

Individuals in an enterprise perform at least those tasks dictated by the technological requirements. It is necessary that the tasks and persons be so matched that it is physically possible for the persons to keep on performing them. This matching process may involve job analysis, selection, training and job redesign. If this process deals only with what is physically possible, it refers to what the task requires of the individual, not what the individual requires of the task. However, as soon as the problem is raised of making it likely that employees will, in fact, perform their tasks, then the enterprise must take account of the psychological properties of its employees and modify its structure beyond what is dictated by technological requirements alone. The dependence of an enterprise upon persons to operate its technology constitutes an inescapable dilemma. It is frequently possible for a "hard-headed" leadership to deny the reality of the problem, but it is extremely doubtful if any institution can persist without accommodating to the fact that whole persons are employed, not just the psychological bits that fit the technological requirements.

> The whole individual raises new problems for the organization, partly because of the needs of his own personality and partly because he brings with him a set of established habits as well, perhaps, as commitments to special groups outside of the organization. (Selznick, I948:26)

For individuals to perform certain tasks, one or more of the following general psychological conditions must exist:

- Performance of the task itself satisfies some psychological needs of the individual.
- Performance of the task is not in itself satisfying but it is an unavoidable prerequisite to achieving other psychological satisfactions (i.e., it has means-characteristics) or avoiding other more unpleasant conditions.
- Performance is induced by demands perceived to arise from the task itself (i.e., it arises from "task orientation").

Only the first and last conditions refer to intrinsic satisfactions of the task. These suggest some ways that tasks may be modified to meet the psychological requirements of workers and align their activities and their interests more closely to the purposes of the enterprise. The second condition covers the typical extrinsic rewards and punishments and the inherent dilemmas (cf. Lewin, 1935, chap. 4). If this is the dominant way of relating workers to tasks, then:

> Much of the enterprise's effort must be devoted to constraints that prevent "unearned" rewards or avoidance of "earned" penalties.
>
> The enterprise's attempts to meet the worker's other psychological requirements (e.g., for satisfying interpersonal relations and for a meaningful relation to society) will be negated in part by unsatisfying task relations.

> Nor does attaching incentives to task perforinance necessarily mean that tasks can be designed solely to meet technological requirements. Close control of the effort/reward relation exerts pressure toward ever greater fragmenting of tasks into measurable individual performance units. This process often goes beyond technological requirements.

Perhaps, despite its drawbacks, this is the only practicable method of relating workers to tasks in modem industry, but it is desirable to consider alternative possibilities.

Both specialist and generalist writings on industry tend to evade the unpleasant side of this problem by assuming that work, at the operative level, is, or could be, a source of immediate psychological satisfaction. The evidence from many occupations and from clinical study raises strong doubts that this is the case. The work of most operatives yields little opportunity for libidinal satisfaction. Only a favored few engage in creative work or work according to their inclinations. For many more there is a sort of satisfaction gained from a habitual work habit fon-ned over the years that Baldamus (1951) has called a "dull contentment." It is a sort of borderline satisfaction, quite distinct from the experience of pleasurable activities or the quieter satisfaction of an engaging task, but quite prevalent in industry.

The third condition under which we might expect people to perform work-task orientation seems to be the only viable alternative to the "stick and carrot." It points in a very different direction, namely, to the specific features of tasks that lead workers to experience different satisfactions in different jobs, even though the money and conditions may be no better. Consideration of workers' task preferences reveals two major factors. One is a preference for tasks that induce strong forces within the individual to complete or continue them, and the other a preference for tasks over which the individual has considerable personal control. These factors contribute to the development of task orientation-a state in which the individual's interest is aroused, engaged and directed by the character of the task.

While it is difficult to imagine in modem industry much increase in creative or libidinally satisfying tasks (despite a reduction of working hours and an increase in time available for libidinal satisfaction), it is possible to conceive of a great reduction in alienating work. If this can be achieved by creating the conditions for task orientation, it need not negate the technological requirements of an enterprise nor seriously modify its primary task or purpose. It is not suggested that these modifications could make work so satisfying as to eliminate the distinction between work and leisure (cf. Curle, 1949). No modification discussed here is likely to lessen the pressure for shorter working hours.

Now let us turn to the conditions under which task orientation will tend to

emerge and the effects it is likely to have. The two prerequisites seem to be:

- The individual should have control over the materials and processes of the task.
- The task should be structured to induce forces on the individual toward aiding its completion or continuation.

Both aspects are often ignored by experimental psychologists because of their assumption that an individual will be motivated to work only when impelled by his or her own internal forces. The present distinction arises from recent efforts to understand those instances in which "there is activity growing out of interest in the task itself, in the problems and challenges it offers. The task guides the person, steers his action, becomes the center of concern" (Asch, 1952:303). This distinction does not imply that personal motivations are absent but asks "whether the ego can lend itself to a task or whether it remains the center of reference" (Asch, 1952:304).

Lacking control over the task, an individual will find himself split between a concern for the task and a constant "looking over the shoulder" at the alien source of control, namely, supervision.

A study of classroom behavior reveals situations so similar as to warrant quoting:

> The child's relation to the learning material is given little opportunity to develop into a spontaneous interest relation because it is overshadowed by the teacher-child relationship. The teacher generally decides what material should be worked on, the relative importance of the different aspects, how it should be worked, the standards of achievement and when work should cease. It is only rarely that the child's behavior is spontaneously oriented towards problems posed by the material itself or guided by the demands implicit in the structure of the material. Because the initiative and guidance come *from the teacher, the behavior of the child is orientedprimarily towards the teacher and not towards the material to be learnt.* (Oeser and Emery, 1954:132)

This similarity enables schools to make a major contribution to the work discipline of society. The concept of work as necessary even if not pleasant and the norms supporting alienated labor will tend to be inculcated during these middle childhood years of socialization (cf. Baldamus, 1957:199-200). Failure of the schools to bring about this resignation to alienated labor could undermine the efficacy of industrial incentives and throw considerable strain on family, work and other institutions that deal with the adolescents.

People alienated from work may identify with and take over the standards of supervisors, but it is also likely that many will "stand outside" the work

relation and seek to "get by" with various techniques of ingratiation or evasion. Outright hostility and refusal to work may also be produced:

> By decreasing the child's possibilities of developing an intrinsic interest in the leaming materials the possibility of an actual conflict between the child's own forces and those of the teacher is also increased. That is, it becomes more likely that the child will perceive the situation as coercive and will attempt to leave it in pursuit of his own interest, or, failing in this, will restructure it to suit his own ends by destroying the leaming materials or challenging the authority of the teacher. (Oeser and Emery, 1954)

The degree of control possessed by an individual will depend on the nature of the task or the authority that is delegated and on the knowledge and skill brought to the task. Thus, the knowledge that a skilled worker brings to a job enables choices of modes and rates of operation not obvious to the unskilled. As pointed out by Jaques these aspects refer to the *discretionary content* of a task:

> all those elements in which choice of how to do a job was left to the person doing having to choose the best feeds and speeds or an impoverished job on a machine; having to decide whether the finish on a piece of work would satisfy some particular customer; . . . having to plan and organize one's work in order to get it done within a prescribed time. (1956:34)

Degree of control also depends on the extent to which an individual is free from inspection or supervisory checkup-what Jaques (1956) has termed the *time span of responsibility*.

The second set of conditions affecting task orientation are structural characteristics of the tasks. Experimental work on learning has amply proven that degree of task structure has considerable psychological influence. If the task is too complicated, an individual, if motivated to learn, will display vicarious trial and error activity. If the task is so simple as to appear "structureless," learning will again only occur if rewarded or punished in a strictly scheduled fashion-a form of blind conditioning. Between these limits is a range of meaningful structure in which the individual learns by varying degrees of insight and, significantly, without extrinsic reward or punishment.

The effect of structure on performance has been less studied. It has, however been demonstrated that

- There can be psychological forces toward performance of a task other than those arising from preexistent needs within the person (cf. Asch, 1952:308-10; Henle and Aull, 1953; Lewis, 1944).
- To the extent that the individual grasps the task and his function, he paces himself within the demands of the system, the needs of the task become

> the environment of requirements to which he subordinates his action (Asch, 1952:175).

Visual attention is similarly influenced by the pattern of changes in the perceptual field (Dember and Earl, 1957). The most general statement of the relation between structure of a task and activity has come from Peak:

> The condition of maximum duration of activity is to be expected, therefore, at some distance-between-parts which is great enough to prevent immediate onset of decrement and yet small enough to provide relatively high probability of continuing transmission of activation from one part of the structure to another. (1958:831)

This principle of optimum structure does not indicate the structural forms most conducive to performance. Baldamus (1951) has done much to bring together the available industrial data. He postulates several forms of "traction" and sources of resistance that commonly arise in modem industry. He distinguishes reactions "according to the external objective cause which tends to bind successive cycles into a continuous flow of activity" (p.48), e.g., fine traction, process traction, batch traction (cf. Smith and Lem, 1955) and object traction (corresponding to the oft observed tendency to complete a whole object). The sources of resistance are located primarily in things that break the continuity of work, e.g., poor tools and materials, brief work cycles. Tasks vary with respect to these features and such variations make it more or less easy or a worker to become absorbed in the task.

Where the definition of the work role and the nature of the task permit the development of task orientation, the following differences tend to emerge between behavior in these conditions and that in conditions of "ego orientation." Ego orientation is assumed to exist when the task provides a means toward achieving a personal goal, e.g., a noxious task performed for substitute or compensating satisfaction. To quote Asch (1952):

> ... task-orientation frees one for seeing and understanding situations in their own terms. In contrast, focusing on the self may interfere with giving oneself to the task, it may restrict or narrow the outlook by introducing directions alien to the task and deprive the person of freedom to abandon predetermined paths and follow in new directions. (p. 311)

> The attitude of intrinsic interest may produce a more serene relation to the task. (p.311) Whether a person can command a sustained interest in a given direction may depend on the nature of his relation to it; if the interests of the ego are no longer served by a given activity, the ground for its pursuit will vanish ...we would expect the dynamics of task-oriented interests to be different, that the activity itself would provide a force for its continuation and proper completion. In general, we would expect a task-oriented person to be more steady and reliable. (p.312)

> ....the important possibility must be considered that the ego may simply not be able to furnish the forces for dealing with certain situations no matter how strong the ego forces may be. (p.3I2)

Unfortunately, many industrial tasks lack the structural characteristics required for task orientation, and the demand for close coordination makes intolerable the discontinuity and variation that arise from delegating responsibility for the task to the individual.

There is much greater scope in the development of group responsibility for group tasks. If the individual's tasks are genuinely interdependent with the group task, then it is possible for the individual to relate meaningfully to his personal activity through this group task (cf. Deutsch, 1949; Horwitz, 1954). A group task, with its greater size and complexity, is more likely to provide structural conditions conducive to goal-setting and striving.

With some autonomy and a wide sharing of the needed skills, a group can provide continuity in task performance unlikely to be achieved by individuals alone or under supervisory control.

Such work groups also counter one undesirable by-product of the individual's alienation from productive activity: his estrangement from his fellow workers. If workers dislike their tasks, they are less likely to maintain relations with others that arise from task interdependence. Attempts by others to get or offer help are likely to be regarded as attempts at manipulation for their own ends. If workers find that participation in the group gives meaning to their activity, their task-mediated relations are likely to become satisfying. Offers or requests for help will tend to be accepted as shared goals and norms, not interpreted as condescension or manipulation.

THE INDIVIDUAL AND THE ENTERPRISE

The discussion so far has concerned one aspect of alienation-of a person from his or her productive activity. Equally significant for the individual, and for the enterprise, is alienation from the product of labor. In modem industry individuals do not claim the product of their labors. Nevertheless, there are good psychological grounds for considering the possibility that an individual may relate to the product that embodies his efforts. Whereas an individual's alienation from activity relates to the task and his work roles, alienation from the product can be considered only in terms of relation to the enterprise; society initially attributes the rights to the product to the enterprise alone. Workers who see this relation isolated from its social context are likely to consider the appropriation of their products as a relative weakening of their position and regard the enterprise's interest in greater production, better quality and less

waste as, at best, no concern of theirs (Walker, 1957). Nor is this effect eliminated if workers do not have, or desire, personal access to these products. Only by meaningfully relating an individual to his society can an enterprise hope to minimize this form of alienation (Gross, 1953). If an enterprise demonstrates distinctive competence in the marketplace, it enhances the possibility that its members will see themselves as meaningfully related to their society through the product of their activities. Neither competence nor market are sufficient in themselves; distinctive competence and market demand are both required.

In summary, the movement toward humanizing industry needs to be refocused from supporting informal defense mechanisms within enterprises to exploring the possibilities of basic, though limited, structural changes.

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