Self-Regulating Work Groups: A Socio-Technical Synthesis

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Self-regulating work groups are a promising alternative to traditional forms of work design. Their emergence from socio-technical systems theory and field experimentation is discussed, and their theoretical bases and implementation strategies presented. Managerial functions appropriate to their design and supervision are also proposed.

Since its conception about 25 years ago at the Tavistock Institute of Human Relations in London, England, socio-technical systems theory has emerged as a significant approach for designing organizations, especially at the people and technology interface (27, 28). This body of theoretical and empirical work seeks to improve productivity and human enrichment through a design process that focuses on the interdependencies between and among people, technology, and environment. A concrete outcome of this theoretical perspective is development of self-regulating work groups. Variously referred to as "autonomous" (12, 13, 17, 26), or "composite" (28), or "self-managing" (14) work groups, these work designs generally include: a relatively whole task; members who each possess a variety of skills relevant to the group task; worker discretion over such decisions as methods of work, task schedules, and assignment of members to different tasks; and compensation and feedback about performance for the group as a whole (14). These attributes are intended to provide the work group with the task boundary, autonomy, and feedback necessary to control variances from goal achievement within the unit rather than external to it. This self-regulating capacity is hypothesized to lead to greater productivity and worker satisfaction.

Existing evidence suggests that self-regulating work groups are productive and satisfying (7). Current knowledge about such applications

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Received 3/29/77; Revised 7/27/77; Accepted 10/13/77; Revised 12/8/77.

is limited primarily to their overall effects, with relatively little practical understanding of how self-regulating groups operate or how they are implemented. This lack of comprehension frequently leads organizations to apply self-regulating designs inappropriately, resulting in confusion and other unintended consequences. Moreover, the literature in this area is somewhat fragmented, making it difficult to develop a coherent theory of self-regulating groups or to conduct research in a cumulative manner.

This article outlines the theory behind self-regulating work groups, their implementation strategy, and the kind of supervision appropriate to their management. Such knowledge is needed if self-regulating designs are to emerge from loose metaphors for worker autonomy to scientifically-sound and practical operational strategies for work design.

Theory of Self-Regulating Groups

Socio-Technical Design

Self-regulating work groups are a direct outgrowth of socio-technical systems theory and design. Briefly, this perspective views production systems as comprised of both technological and social parts. The former consists of the equipment and methods of operations used to transform raw materials into products or services; the latter includes the work structure that relates people to the technology and to each other. A traditional division-of-labor work design, for example, relates workers to limited and highly-prescribed parts of the production process and to a narrow set of physically-proximate employees performing similar jobs. The concept of a socio-technical system arises from the consideration that any production system requires both a technology and a work structure (22). Since the work structure ties people to the technology, its design has a major impact on both of these substantive dimensions of work.

Based on this simple, yet often neglected premise, socio-technical experimenters attempt to design work structures so that a "best match" is obtained between employees and technology (12). This may involve changes in the technology (i.e., equipment and process layout), the work structure (i.e., work roles and their interrelationships), or both. The primary aim is to design a work structure that is responsive to the task requirements of the technology and the social and psychological needs of employees: a structure that is both productive and humanly satisfying. A division-of-labor work design, for instance, may well meet the task demands of a mechanized assembly-line and the needs of individuals who prefer direction and social isolation; yet, it is questionable whether this work structure would satisfy the task requirements of a research team or the needs of employees who desire autonomy and social interaction.

Beyond matching the social and technical dimensions of work, socio-technical systems must also relate effectively to their task environment — those external elements that are relevant to the setting and achievement of system goals (9). For many work systems, such as lower-level production units, the task environment consists primarily of other organizational units internal to the total organization. Conversely, other work systems, such as higher-level staff groups, engage a task environment that is predominately external to the organization.

Given this system and environment interdependence, socio-technical designers attempt to structure work systems so that they can meet environmental demands while remaining relatively resilient to external disruptions. This may involve changes in the system or the task environment. A work group may be given discretion to alter its production methods to account for changes in the quality of its raw materials; similarly, it may pressure the purchasing department to tighten the quality standards for raw materials inventory. The essential design issue is to match the work system to its task environment.

Unit of Design and Locus of Control

Self-regulating work groups are an attempt to design effective relationships between the so-

cial and technical components of work systems and between the systems and their task environments. Although such designs have been employed in a variety of work settings, at least two issues underlie their use: the relevant unit of design (i.e., groups versus individual jobs) and the locus of control (i.e., internal versus external to the system).

Socio-technical designers typically use the work group rather than the individual job as the basic building block of work design. The tendency is to group employees who perform interdependent tasks into a common work unit that is relatively differentiated from other units. This grouping appears necessary when the technology is such that interdependence among workers is essential (14). Referred to as "technically required cooperation" (20), this dimension is present in production systems where workers must share, in addition to time, the same equipment or materials to achieve a productive outcome. Examples of this include: oil refineries, where employees are responsible for materials flowing through the plant; coal mines, where workers are sequentially dependent on the output of previous employees; and hospitals, where a combination of techniques are applied concurrently to the same material. Under these conditions, group designs that account for necessary task interdependencies seem more appropriate than individual job designs. The obverse appears to hold in those situations where technically required cooperation is low (e.g., key punching, telephone installation, and field sales).

An underlying objective in designing any work system is to reduce variance from goal attainment (5). This involves a choice between two fundamental forms of system control: elaborating external mechanisms of control (i.e., hierarchical supervision, scheduling, and standardization) or increasing the internal control of members of the system (i.e., giving employees the autonomy needed for self-regulation (11). Socio-technical designers tend to structure work so that variance is controlled within the work system rather than external to it. This seems necessary when external control mechanisms are unable to reduce the uncertainty facing work systems. Specifically, two major sources of uncertainty affect goal achievement: those concerned with transactions across the system's boundary (e.g., scheduling input and output exchanges with the task environment) and those involved with the conversion of raw materials into finished output (e.g., operating production technology) (26). Boundary-transaction uncertainty is likely to be high when the work system's task environment is relatively complex and changing. Since the parts of the environment are richly interconnected and fused with a change gradient, it is difficult to know what, where, and when inputs and outputs will enter or leave the work system (e.g., the number and characteristics of students enrolling in a particular university course may be difficult to predict and control). Similarly, conversion uncertainty is likely to be high when there is incomplete technical knowledge about how to produce a desired outcome (e.g., surgery, psychotherapy, education, etc.). When either boundary-transaction or conversion uncertainty is high, external controllers, such as supervisors and technical staff, find it difficult to program the flow of inputs and outputs or the conversion activities of the work system. Rather, these regulatory functions are more effectively performed by those employees who are closer to the sources of uncertainty.

Conditions for Self-Regulation

The design of self-regulating work groups depends on at least three conditions that enhance technically required cooperation and employees' capacity to control variance from goal attainment: task differentiation, boundary control, and task control (6). Task differentiation refers to the extent to which the group's task is itself autonomous forming a self-completing whole. The more autonomous the group's task, the more differentiated its task boundary from other organizational units. This task discontinuity facilitates technically required cooperation by bounding interdependent tasks into a com-

mon unit and aids variance control by increasing the likelihood that technical variances will be contained within the work group's boundaries rather than exported across them (21). For example, an assembly line may be divided into relatively differentiated task groups through expedient placement of buffer stocks and inventories; this may in turn help to restrict technical variances to discrete segments of the line. The opportunity to form whole task groups may be limited by such technological constraints as equipment size and location and length of the production cycle.

Boundary control involves the extent to which employees can influence transactions with their task environment (e.g., the types and rates of inputs and outputs). The major factors contributing to boundary control include: a well-defined work area which individuals can identify as their own territory (22); competent members who possess an adequate repertoire of skills which frees them from having to rely on external resources for task performance (18); and group responsibility for boundary control decisions (e.g., quality assurance) which reduces dependence on external boundary regulators (e.g., inspectors). The combination of these characteristics helps group members protect their work boundaries from external intrusions and perform selective environmental transactions.

Task control refers to the extent to which employees can regulate their behavior to convert raw materials into finished products. This factor is enhanced when group members are given: freedom to choose work methods and to adjust work activities to match task and environmental demands (17); influence over production goals allowing employees to modify their output as emergent situations are encountered, such as unpredictable breakdowns and stressful working periods (10); and feedback of relevant measures of group performance which provides the knowledge of results necessary for goal directed behavior (10, 17).

The above mentioned conditions — task differentiation, boundary control, and task control — relate directly to a group's capacity for self-regulation. Since the extent to which these conditions must be met to consider a group self-regulating is currently unknown, they are probably most useful in determining the relevance of particular organizational variables for self-regulation. This is a pertinent point, for many attempts to implement self-regulating groups have involved a number of organizational changes (7). Given this variety of potentially relevant organizational variables, it is important to know which factors are necessary for self-regulation and which are redundant or extraneous. The conditions discussed here can serve as a guide for identifying relevant changes and for understanding them conceptually.

Conceptual clarity concerning the interrelationship of self-regulating conditions is especially needed. Task differentiation and boundary control probably are related curvilinearly. Groups that score low on the task dimension may have such highly diffuse task boundaries that members are unable to differentiate themselves clearly from other organizational units, making boundary control difficult, if not impossible. Conversely, groups that score high on the task variable may have such highly differentiated task boundaries that mutual relations with external units are severely restricted (1). This may impede environmental exchanges required for task performance (e.g., the attainment of needed raw materials). One would expect a similar relationship between task differentiation and task control. Highly diffuse task boundaries may make it so difficult to separate the group's task from the task of related units that members are unable to control task-related variables, such as production scheduling. Highly differentiated task boundaries may lead to such high group cohesion that members reduce their openness to task-related inputs, such as performance feedback and managerial support. Such rigidity may also cause external others, such as management, to retaliate by withholding resources, information, or freedom needed for task control. The

final relationship, between boundary control and task control, is likely to be positive. The more members influence transactions with their task environment, the more they regulate their behavior toward task achievement. Presumably, increased boundary control enhances members' ability to engage with external units, including management, to obtain relevant feedback and freedom to control task variables. This depends on whether such attempts at environmental influence are perceived and acted upon positively by external others. If boundary control is experienced positively by external others, it is likely to improve task control; otherwise, it may thwart it.

The above discussion suggests possible relationships among the self-regulating conditions. Further study is needed to clarify these interactions. Specific information about the shape, direction, and strength of the relationships would provide a more accurate account of how the different properties of self-regulating groups affect each other systemically. Moreover, research into this issue would likely uncover a variety of other variables that moderate these relationships, such as group size, organizational climate, and type of technology. Such knowledge is a necessary step toward explaining the conditions needed for self-regulation and how these operate in organizational settings.

While the previous discussion was aimed at how self-regulating groups promote required cooperation and employees' competence to respond to technical and environmental variances, how such designs affect the social and psychological needs of employees is equally important. Hackman and Oldham's (15) theory of job design suggests a framework for understanding how self-regulating groups affect individuals motivationally. They identify three psychological conditions that lead to both work effectiveness and personal satisfaction: (a) personally meaningful work; (b) responsibility for work conditions; and (c) knowledge of results. These states are present when the work content is high on the following five core dimensions: (a) skill variety; (b) task identity (i.e., ability to complete a whole piece of work); (c) task significance (i.e., degree to which the job has a substantial impact on the lives or work of other people); (d) autonomy; and (e) feedback.

When the conditions for self-regulation are implemented effectively, they seem to score high on all these work characteristics. They provide group members with the opportunity to use different skills, to complete a meaningful piece of work, to perform tasks that affect other team members, to make important work-related decisions, and to learn how well they are doing, Therefore, the combination of these work elements is likely to satisfy employees' needs for responsible autonomy over a meaningful task, at least for those individuals who have such needs.

The similarity of Hackman and Oldham's (15) job design characteristics and the self-regulating conditions of work groups suggest a common ground for integrating these two streams of theory and research. The former perspective views work variables primarily from a concern for individual motivation and the latter from a need for required cooperation and control of technical and environmental variances. This contrast, relatively neglected in other attempts to integrate these approaches (14, 23), suggests that each work characteristic may have two distinct yet complementary facets: one related to motivation and the other to self-regulation. For example, skill variety, task identity, and task significance each contribute to the psychological condition of personally meaningful work. They also enhance self-regulation: skill variety provides the behavioral flexibility necessary to develop group strategies for coping with changing task and environmental conditions; task identity furnishes the differentiated task boundary needed for grouping interdependent tasks and containing technical variances within a common work unit; task significance provides the social interdependence needed to relate individual task contributions to those of other workers. This distinction between motivational and self-regu-

lating views of work characteristics raises the issue of how the work variables affect individual performance and satisfaction. Do they affect work outcomes primarily through their impact on individual psychological needs, or on workers' ability to develop a work structure for coping with technical and environmental demands, or on some combination of both? Research into this complex issue is an important starting point for integrating these so far separate perspectives.

Implementation of Self-Regulating Groups

Developmental System Design

The formation of self-regulating work groups typically follows a design strategy that facilitates group development toward responsible autonomy. Referred to as "developmental system design" (18), this process recognizes that self-regulation cannot be created in a one-step mechanical manner. Rather, the conditions for self-regulation (i.e., task differentiation, boundary control, and task control) may require considerable time and diagnosis to implement fully. This is especially relevant for the social aspects of work groups, such as group decision-making, task interaction, and other internal dynamics that occur among group members. These social conditions are not created by design fiat, but through careful attention to the processes by which group members develop their own ways of working together and of adjusting their internal activities to changing task and environmental circumstances. Given the substantial evidence about the ways that groups can thwart work effectiveness and members' well-being (2, 19, 29), development of an effective social system needs to be an explicit part of the design process. Indeed, it is probably the most salient feature distinguishing the design of self-regulating groups from that of enriched jobs.

Developmental system design starts from diagnosis and specification of the structural properties needed to form self-regulating work groups. These include: a clearly differentiated group task, a well-defined work area, and relevant measures of performance. These provide the physical and task boundaries for the group and the standards against which variances are monitored and controlled. Training employees to perform the requisite tasks is also a preliminary design issue. Although it seems desirable that all members initially learn all the tasks for which the group is responsible, it is probably more realistic to assume that each worker will acquire the full complement of skills on the job.

The design properties outlined above are aimed primarily at structuring the technical component of the work group and providing employees with the skills necessary to operate it. The problem of forming an effective social system is a more process-oriented task. This requires an understanding of how groups develop from a loose aggregate of individuals into a well-integrated, problem-solving unit. Although this issue has not received adequate attention in the socio-technical literature (14), there is a substantial body of theory and research about group development. Heinen and Jacobson (16) have integrated much of this literature into a pragmatic framework that is particularly relevant to self-regulating groups, since it accounts for the different kinds of issues that such groups are likely to face at each stage of their development — i.e., from an initial forming stage to a more mature phase.

Although it is beyond the scope of this article to present the strategy more fully, it is important to note that such process interventions are best used to support and maintain a self-regulating group that is initially well-designed (14) (i.e., that has a clearly differentiated task boundary, that is staffed with competent members who possess requisite skills, that has relevant feedback of performance, etc.). Given these conditions, a group consultant or leader who is trained in group process skills (e.g., a process consultant (25)) can help members work through their interpersonal and procedural problems and devise performance strategies (14) appropriate to carry-

ing out the group's conversion and boundary-transaction tasks.

Organizational Context

This discussion has concentrated on self-regulating groups in relative absence of their organizational context. The larger organization has a major impact on whether such structures can be implemented effectively. Foremost among these external conditions is the structure of the organization. This appears to affect both the internal dynamics of the group and its relationships with other organizational units. Since self-regulating groups tend to be organic in character (4), an organization structure with similar dimensions would likely support and enhance the group's internal development (14) (i.e., a structure with flexibility among units, decentralized authority, few formal rules and procedures, etc.). Moreover, an organic form of organization where there is a network structure of control, authority, and communication would also tend to promote interdependence among parts of the organization. This would increase the likelihood that a self-regulating group's boundaries remain permeable to mutual relationships with other organizational units, such as plant maintenance, procurement, and technically-realted groups. A more mechanistic form of organization (4) would tend to place severe constraints on self-regulation. A hierarchic structure of authority and control, a precise definition of rights and obligations, and functional specialization of tasks would likely thwart a group's autonomy and flexibility, reducing its capacity for self-regulation (14). Group members would also tend to withdraw from the organization and enact rigid boundaries to protect their autonomy, thus reducing their mutual contacts with other organizational units.

The climate of the organization also affects implementation of self-regulating groups (8). Since such work designs may involve changes in the organization's reward system, power relationships, communication flows, work flows, and status hierarchies, organizational members must be capable of dealing with these related issues if work is to be redesigned effectively. Argyris (3) suggests that an organizational climate that fosters interpersonal openness, experimentation, trust, and risk-taking behavior is conducive to such structural changes. A review of sixteen selected autonomous group experiments seems to support this premise (7). In most cases, successful implementation of self-regulating designs followed from an organizational change strategy where experimentation, trust, and collaboration among workers and managers were relatively high.

Beyond the structure and climate of the organization, a number of more pragmatic organizational practices are likely to enhance self-regulating groups. Specific organizational measures that tend to promote group (as opposed to individual) forms of work include: a group-based pay scheme; performance data relevant to the group as a whole; self-selection of group members; and low turnover of group personnel (26). Similarly, organizational practices that are likely to nurture learning and responsible autonomy are: protection of the group during its early growth stages (e.g., reduced pressures to perform); wage and job security (e.g., a formal agreement among workers and management guaranteeing that no reductions in wages or employment will result from experimenting with new ways to work); and alternative work opportunities for those group members who become disenchanted with group forms of work (8).

Supervision of Self-Regulating Groups

Self-regulating work groups are designed to take on many of the functions traditionally ascribed to management (e.g., assigning members to individual tasks, determining methods of work, controlling task variances, etc.), but this does not mean that external supervision is unnecessary. The supervisory role emerging under such conditions involves two major functions: developing group members and helping the group maintain its boundaries (8, 26).

Developing group members for a self-regulating system requires a consultative style of management. The supervisor helps members organize themselves into an effective team that is capable of responsible autonomy. The essential task is to provide the group with clear boundaries for the exercise of discretion and to assist members to acquire the skills and knowledge to carry out the work assigned. Since first-level management is the critical link between the wider organization and the group, the supervisor's behavior largely determines how much autonomy workers can experience and how much support and encouragement is received from the organization.

Helping the group maintain its boundaries is necessary if members are to sustain sufficient autonomy to control variances and relate to their task environment. Referred to as "boundary management" (8, 26), this supervisory function operates in two directions: outward to the group's task environment and inward to its conversion activities. Since work groups have limited control over their task environment, supervision must help to reduce the environmental uncertainty facing the group. This may include a number of strategies for controlling the flow and acceptability of the group's inputs and outputs (e.g., maintaining alternative sources of raw material, scheduling inventories, negotiating delivery dates for finished products, etc.). It may also involve mediating relationships with other organizational units that affect the group's performance, such as higher-level management, plant maintenance, and related groups in other territories or on other work shifts. Research into the management of lateral and horizontal relationships with the task environment suggests that the former may be more difficult, more lengthy, and involve more negotiation contacts than the former (24).

Focusing on the group's conversion activities, management may assist group members to control those variances that are beyond their knowledge and skills (e.g., handling raw materials with unusual properties, deciding whether to scrap or rework an expensive product, etc.). Supervision may also help the group to formulate a task definition appropriate to the group's technology and acceptable to the larger organization (e.g., defining textile weaving in terms of a set of looms for a group of workers (22)). Finally, management may assist group members to plan for a desired future and to problem-solve ways to bring this about, which may result, in turn, in redefining the group's task or redesigning the group itself.

The above discussion suggests that the supervision of self-regulating work groups may require skills and expertise that are not familiar to traditional line managers (8, 14). Among these skills are: knowledge of group dynamics and socio-technical principles; understanding the group's technology and task environment; an ability to intervene in the group and develop members' capacity for responsible autonomy.

Conclusion

Self-regulating work groups are a valuable contribution from socio-technical systems theory and practice. Their growing use in organizations in a number of industralized countries suggests that they are a unique and viable alternative to traditional forms of work design. Their popularity, however, may lead organizational members to overestimate the general applicability of self-regulating groups or to underestimate the conditions necessary for their implementation and continued effectiveness. This article has attempted to provide a clearer understanding of the conditions, implementation strategy, and supervision needed for effective self-regulation.

The discussion suggests some preliminary propositions that may lead to much-needed research in this area:

1. To the extent that technically required cooperation and boundary-transaction or conversion uncertainty are high, self-regulating work groups are more task effective than individual job designs.

2. Self-regulating groups are more task effective to the extent that members have: (a) a moderately differentiated task; (b) high boundary control; and (c) high task control.

3. Self-regulating groups are more personally satisfying to the extent that members have: (a) the conditions in Proposition 2; and (b) needs for responsible autonomy over a meaningful task.

4. Self-regulating groups are more effectively implemented to the extent that: (a) attention is given to the social processes by which members develop their own ways of working together and of adjusting their activities to task and environmental conditions; (b) their organizational context is organic; and (c) their organizational climate fosters experimentation, trust, and collaboration among workers and managers.

5. Management of self-regulating groups is more effective to the extent that supervisors: (a) provide clear boundaries to the exercise of discretion; (b) assist members to acquire the skills and knowledge to carry out the work assigned; and (c) manage group boundaries both outward to the task environment and inward to conversion activities.

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