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Action Research in an American Underground Coal Mine[1]

Laying the Groundwork for an Experiment: May to November 1973

Conditions Leading to an Agreement

In May 1973, Warren Hinks, president of Rushton Mining Company, and Arnold Miller, president of the United Mine Workers of America (UMWA), signed an agreement to undertake an experiment to create opportunities for autonomy and participation for workers within an operating face section of a coal mine. An operating face section rather than a mine as a whole was chosen as the unit of change because there was no previous experience in the U.S. mining industry with an innovation with such far reaching implications. The change was labeled "experimental" to give all interested parties an opportunity to assess its consequences before making a formal commitment to it. It was thought unlikely in 1973 that any management or local union would commit to a change of this kind without such provisions or commit to changing an entire mine at one time.

Several converging factors made such an agreement feasible at that time. In late 1972, the UMWA ousted a corrupt and scandal-ridden administration and elected a new reform-minded president whose campaign platform included a major focus on safety. The newly elected president appointed several young staff members who were interested and knowledgeable about

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[1]A revised and expanded version of the original, "An Experiment in Autonomous Working in an American Underground Coalmine." Human Relations, 30:201-36, 1977.

worker participation in decision making and aware of the positive results of the pioneering work on autonomous work groups undertaken by the Tavistock Institute in the British coal industry (Trist et al., 1963).

The president of Rushton was also concerned about coal mine safety. He felt that more was required than was provided for by the provisions of the recently enacted Coal Mine Health and Safety Act and that greater external inspection and sanctioning, although necessary, could only be partially effective and that full effectiveness required more intensive training of foreman and workers. He also believed that the increasing rate of absenteeism in the industry (then about 13 percent) was a safety hazard. Workers who have been rescheduled by management to fill critical vacant positions perform tasks they do not regularly do and perform them with workers with whose habits and skills they are unfamiliar. Hinks also expressed concern about a new generation of miners who were younger, better educated and more militant than past generations. He was willing to explore any organizational innovations that would curb the increasing number of wildcat strikes and improve industrial relations in general. Hinks was receptive to the idea that increased involvement of workers in decision making and an overall improvement in work quality through the use of autonomous work groups might be a means to improve safety as well as increase productivity. He was thus willing to give the concept a try.

The research team received funding from the National Commission on Productivity and Work Quality and subsequently from the National Quality of Work Center (NQWC), affiliated with the Institute for Social Research, University of Michigan. These two agencies, federal and quasi-public respectively, were perceived as neutral third parties by management and the UMWA. Other relevant governmental sources were rejected due to

suspicion by either management or the union. The agencies established the following guidelines for support of the experiment:

> Funding would cover an 18-month period. Complete funding would be provided for the initial six months. During this time, management and the union would develop conditions under which an experiment would proceed. Half funding would be provided for the next 12 months, during which the actual experiment would be conducted. Management and the union would make up the other half in proportions to be decided. These funds were only to cover the research team's daily rates and travel expenses.
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> Management and the union must agree to develop a formula for sharing any gains resulting from improvements in performance.
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> A separately funded evaluation team would collect attitudinal and performance-related data and provide these to all parties by the end of the 18-month experimental period.[2]
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> A further evaluation would take place at the end of three years to see if the experiment and its outcomes were self-maintaining. The view of the funding

[2]The evaluation team was headed by Paul Goodman, Carnegie-Mellon University, on contract to the Institute for Social Research of the University of Michigan, which is responsible for the evaluation of all NQWC projects on a common model and is funded by the Ford Foundation.

agencies was that wider acceptance of the results would be assured if the larger publics concerned knew that the evaluation was done by an independent group with no vested interest in the program's outcome.

Development of the "Document"

A mechanism had to be developed to assure management and the union that both would retain joint ownership of the project as well as an equitable distribution of gain-sharing. The mechanism was a labor-management steering committee consisting of nearly all mine management above the foreman level (plus some foremen) as well as the local union officers and members of the Health and Safety and Mine (grievance) Committees. The steering committee met throughout the summer of 1973 and developed what became known as the "document." The document laid out the terms and conditions under which the experiment would proceed and be evaluated. Highlights of the document included selection of men, selection of the experimental section, new duties of the foreman, etc. There was agreement on modifying four basic provisions of the contract then in effect.

Elimination of pay differences on the experimental section for different job classifications. Mine management agreed to pay all members of the crew the top rate of $50.00 per day as the contract stood at the program's commencement.

Bypassing of the grievance mechanism and establishment of a joint committee at the mine site to oversee the experimental section and to handle all grievances that

arose from it.

Freedom for crew members to learn new jobs within their section without these jobs having to be bid or posted minewide.

Relinquishment of management's right to direct the crew members at the work site.

The document was taken to the local union for membership vote in October 1973 and was accepted.

Selection, Orientation and Training of Volunteers: December 1973 to March 1974

Selection of Volunteers

Twenty-four bids were posted (three eight-man crews), and the steering committee reviewed volunteers on the basis of seniority and job qualifications. The mechanics on the section did not volunteer but were assigned by the maintenance foreman. Two support positions were added to the section for reasons explained below. Under the existing union contract, miner operators and mechanics earned the top rate of $50.00 per day, miner helpers and roof bolters earned $47.25 per day, shuttle car operators earned $43.25 per day and support men earned $42.75 per day. Volunteers, their number given in parentheses, gave the following reasons for wishing to become members of the newly designated section (each worker was

allowed to cite more than one reason): more money (7); better physical conditions (4); be my own boss (2); assigned by maintenance supervisor (2); learn more about mining (1); car pool buddy on section (1); get away from foreman who pushes for production (1); do my own thing (1). The age distribution of volunteers was 20-29 (12); 30-39 (7); 40-49 (3); 50-65 (5).

Orientation Period

A six-session orientation period began in December 1973; each session lasted for a full oupday in the mine classroom. There was a Monday and a Friday meeting for each of three weeks. Tuesdays, Wednesdays, and Thursdays were regular working days on the new section. During orientation meetings, the document was reviewed, autonomous work group concepts explained and all job tasks reviewed. The men received a job safety analysis program and a review of the state and federal safety laws. In addition, experiential exercises in group relations and problem solving were given, generally within the context of issues that the steering committee had not foreseen and which required resolution. The men were all experienced miners who claimed to know and to have sometimes done all the face jobs. Hence, it was proper that all should receive the top rate from the beginning.

Training and Adjustment Period

A six-week period then followed during which the men worked at the jobs they initially bid on, but were encouraged to relearn as many of the other jobs as possible. They were to familiarize themselves with state and federal laws and begin to learn to manage their section. As the primary focus during this period was on training and learning, management agreed to a

moratorium on pressure for production. In February 1974, the section elected one man from each crew to be a representative to the joint committee and also elected two representatives from the local union leadership. Management appointed five members. Thereafter, the labor-management steering committee declared the section autonomous and withdrew from active involvement in the project. The steering committee was to be reconvened to evaluate the project at a later date and to decide if additional sections should be initiated.

Socio-Technical Analysis: March 1974 to April 1975

The original experimental "year" was extended to 13 months due to the month-long national strike of November 1974. The research team's contributions over the next thirteen months can be divided into two basic categories:

> a socio-technical analysis of the room-and-pillar method of coal-mining when utilizing continuous mining equipment; and
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> introduction of several mechanisms for training and development as well as for conflict resolution, but most importantly for encouraging continuous planning and problem solving at several levels of the mine organization.

These contributions were not independent of each other; they proceeded in tandem and each influenced the conceptualization as well as the form in which concrete proposals of either category were offered. The contributions of the research team during this period were continuous

rather than in the form of reports at specified intervals to the steering committee. Such an approach was compatible with the role the research team had conceived for itself, that of collaborator in a joint learning venture in which management and the union would develop and evaluate new methods.

The Technical System

In the continuous mining of coal by the room-and-pillar method (Cassidy, 1973), coal is cut at the face by a large machine with a continuously rotating drum studded with sharp bits. Below the drum, coal is gathered by large crablike arms and dumped onto one of two shuttle cars that are alternately filled and then driven down a pathway to a feeder, where the coal is emptied onto a continuously moving belt conveying the coal to the surface. Each time the face is cut 20 feet wide and 18 feet deep, the mining machine (the continuous miner) is withdrawn to a new face, leaving space for the newly exposed roof to be first timbered and then bolted. This sequence of activities constitutes the basic conversion process in development of a section. What remains after a section has been developed gives a checkerboard appearance of alternating open rooms and solid pillars. Following section development, the coal is removed from the pillars, causing a controlled collapse of the roof that is preceded by retreat of the mining equipment to a new pillar further from the original working face. Against this "figure" of activities is the "ground" consisting of preparatory/maintenance tasks, e.g., repairs, moving supplies. All preparatory/maintenance tasks are essential to continuance of the basic conversion process.

The seven men on each shift of a typical face section include the miner operator, who runs the continuous miner; the miner helper, who places timber at the freshly cut face, hangs

ventilation curtains, moves power cables that energize the continuous miner, etc.; two shuttle-car operators; two roof bolters; and the mechanic. Support work, including maintenance of conveyor belts, building "brattices" (permanent ventilation stoppings), laying tracks, hauling supplies to the face, etc., is typically carried out by the general underground work force.

Analysis begins with recognition that conversion by the coal-mining industry from conventional (low mechanization) to continuous (high mechanization) methods fundamentally altered the nature of the technical system. The essential feature of this conversion was to change the key contribution of humans from coal getting (a large machine now cuts the coal) to assuring that maximum use is made of the equipment and that breakdowns are minimized. There is, at the present stage of technological development, a significant discontinuity between the technical system's basic components. The productive capacity of the equipment far exceeds the capacity of the rest of the system to effectively and efficiently move coal from the mining equipment to the surface. If the continuous mining equipment were to run continuously, as its name implies, it would be capable of cutting up to 4,000 tons per shift (Faltenmayer, 1974); however, due to time consumed in moving the continuous miner from one cutting face to another, waiting time between shuttle cars, delays due to mechanical breakdowns, poor communication, unnecessary or poorly timed moves, etc., the continuous miner cuts only 350 to 400 tons per shift. The continuous miner can be used more effectively if the focus of human contributions shifts from coal getting toward eliminating problems such as those discussed below.

Psycho-Social Consequences of the Technical System

Isolation of the Men During Work Performance

During an eight-hour shift, effective operation of the mining system requires that there be a shared understanding among shift members and between themselves and the foreman concerning what is required to minimize delays and shutdowns. Yet, becaue of the nature of underground mining, once work has begun, communication and coordination on a real-time basis is inhibited by distance between work sites as well as by darkness. Coordination improves when consensus is established before the shift begins so that everyone has a shared "map" of what is required and when. Current management practice places the entire responsibility for coordination on the foreman. He is the "glue" that pulls all the tasks together. Yet underground conditions make it very difficult to carry out this responsibility effectively.

Continuity Between Shifts

The manner in which each shift performs its tasks and the conditions in which it leaves the section significantly influence the performance of the next shift. Current management practice considers the shift and the individual foreman as the primary production unit. This encourages competition between shifts where cooperation is vital. The consequence of this competition is gamesmanship, in which winners get high tonnage and losers are left with bad conditions and, consequently, lower tonnage. Instead of planning to set up the next shift so that maximum coal will be mined across three shifts, the foreman and shift members use their planning abilities to thwart the other crews.

Uncertainty of Conditions

About every 10 days, the mining system is literally picked up and moved 180 feet

forward. With every such move, crew members must cope with new geological conditions and, as progress is made toward the next move, shuttle-car paths lengthen and the distance between support and facemen increases. Furthermore, even with the most diligent efforts at preventive maintenance, equipment breakdowns occur. These and other similar contingencies make it difficult to anticipate the conditions under which work and its coordination take place.

The traditional factory, facing relatively constant conditions, may be able to cope with its production system by assigning to each worker a set of tasks that only he or she is permitted to perform. This method of job assignment is prevalent in the mining industry today but is inappropriate to the conditions of uncertainty with which crew members and their foremen must cope.

Concepts Contributed by the Research Team

Double Bind on Foremen for Production and Safety

Current management practice places foremen in a double-bind conflict in that higher management holds them solely responsible for both production and safety. Foremen are the repository of an industrywide conflict, the burden of which they must bear internally. If production is lower than expected, they are held accountable. If an accident or violation occurs on their section, they are held accountable both to management and to state and federal regulatory agencies. This conflict prevents them from giving primary attention to either and tempts them to vacillate between meeting one goal or the other.

The Best Match Between the Social and Technical Systems

The design process is a search for the best solution to a set of conflicting requirements. The best solution is necessarily an innovation as well as a work of art in the broadest sense of the term. If the solution were obvious, it would be merely calculated; there would be no design problem as such (Alexander, 1964). Additionally, the research team believes that it is neither necessary nor desirable that they be the innovators while management and the union are solely the consumers. The ultimate design that evolves requires the resources of the men, the union and the management. While no clear-cut division of labor exists among these contributors, the research team viewed itself as a catalyst and facilitator of problem solving by the other parties. The team's role was to introduce concepts and encourage discussion. Those who use the design must believe in it and "own" it. The final form it takes must, therefore, be the result of the efforts of all.

Redefinition of the Primary Task

When the social system members' definition of their primary task is congruent with what the technical system is designed to do, both systems can be more effectively utilized. Acceptance by management and section members of the definition of continuous mining as a transport system rather than as a production system will encourage both to be alert to key variables that affect the performance of a transport system. For example, search is likely to intensify on how to maximize use of the continuous miner while at the cutting face as well as to minimize delays and shutdowns.

Performance and Measurement of the Primary Task

The primary task may have a "pull" of its own if performance is evaluated per belt move (approximately every 10 days) in the context of the type of mining (e.g., development vs. pillars) and conditions faced, costs incurred, etc. If performance is fed back to section members in units such as these rather than in units that are accounting conveniences, the units will "stand by themselves" as bases around which activities are organized.

Performance data should be evaluated according to social units containing those members whose activities are most interdependent in pursuit of the primary task. In continuous mining the section of three shifts, not the single shift, is the natural unit containing those men and tasks that are most interdependent in operating and maintaining the transport system.

Dealing with Uncertainty

Technical and geological conditions creating high uncertainty and task interdependence are best dealt with if several group members possess the necessary skills to deploy when unanticipated events arise. Delays will be minimized if corrective action is taken by those located closest to the events rather than by relying exclusively on those who claim a specific job title. A reward structure that minimizes status differences between crew members will encourage the learning of more than one job.

Additionally, more effective deployment of the group's skills should result when all group members are familiar with prevailing physical conditions as well as with each other's skill capacities and work habits. Therefore, containment within the work group of sufficient skills to carry out all relevant tasks should reduce the need to employ nongroup members to

handle peripheral group activities as well as to substitute for absent group members. In contrast to the six-man shift utilized by other face sections where support work is done by the general underground work force, autonomous sections should have two additional members to perform the section's support work and fill in for vacant face positions. This arrangement is no more than a reassignment of manpower from one organizational unit, namely, the general underground, to another unit, a face section. No increase in overall manning is required.

The Shift Foreman's Role

The social system that approaches the best match with the technical system of continuous mining contains a redistribution of responsibilities between the foreman and crew members. Crew members should be made responsible for coordination of daily activities both within the crew and between crews. They are closer to the work than the foreman and can effectively coordinate their immediate activities. The foreman, being relieved of day-to-day production responsibilities, is freed to study the law and ensure its enforcement. Freedom from day-to-day responsibilities should provide the foreman an opportunity to develop a longer time horizon; for example, to learn to plan better for supply requirements, to see potential breakdowns before they occur and to plan for their systematic repair in conjunction with the maintenance department. Furthermore, a longer time horizon will permit foremen to place daily production within the context of the overall mine development plan. Instead of directing the crew, they can use the knowledge they gain from the above activities to become "resource" persons to crew members. Their contribution to production will be to provide information to crew members, to help them to use that information most effectively and, in discussion sessions, to facilitate the

development of a consensus concerning activities to be carried out during the shift. The latter involves skills that most middle and upper level managers are encouraged to learn early in their careers. Although no less important at the foreman level, the learning of these skills has been neglected.

Institution Building

Throughout the next 10 months, the research team concentrated on the building of several mechanisms for training and development as well as for conflict resolution.

Section Conferences

At approximately six-week intervals, the entire 27 members of the section and the three foremen met in an aboveground classroom where events of the last six weeks were reviewed and the next six weeks planned. During these meetings the men were paid their regular daily rate. This time for review and planning was considered by the men and by management as of no less importance than time on the job. Each believed it would pay off in more effective performance in the long run. After each six-week interval, the research team systematically gathered data on absenteeism, productivity, supply costs and delays for feedback and discussion at section conferences.

Underground Visits

Twice a week during these 10 months two graduate assistants (doctoral

candidates), Melvin Blumberg and James Thurman, made underground visits. They were instructed to reinforce the concepts discussed in the classroom meetings, to follow up on ambiguities and to collect information to discuss at the next section conference. Grant Brown, a mining engineer on the staff of the Mines and Minerals Department, Pennsylvania State University, was originally to spend considerable time with each section at the coal face. However, a new department chairman at his university refused to let him be away this much, which seriously limited what was accomplished in developing new work methods and understanding.

Joint Committee Meetings

The joint committee met at irregular intervals throughout the spring to settle disputes that had arisen on the autonomous section. Beginning in September 1974, the joint committee began to meet regularly to discuss gain-sharing issues. Issues raised included how gains would be measured and divided, among whom the gains would be divided, etc. The research team considered it important in social dynamic terms that these issues be thoroughly explored before it was determined whether or not any gains might exist.

Foremen Meetings

Beginning in January 1974, the three foremen and other members of management met approximately every two weeks with the research team to discuss issues related to their own development and training. A four-point agenda was developed:

Safety. What unsafe acts did you stop crew members from doing since our last meeting? What violations did you observe and what corrective actions did you take?

Training. Who in the section has learned a new job or task?

Inside-outside relations. Issues related to supply ordering, preventive maintenance and development decisions were discussed with appropriate members of management who were asked to attend these meetings.

Planning and consensus building skills. Experiential exercises were given concerning problem-solving skills, conflict resolution, etc.

Management Meetings

Beginning in December 1974, these meetings, consisting of the highest levels of mine management, took place irregularly with overlapping sets of participants. The purpose of these meetings has been to discuss ad hoc problems as they emerged. It was agreed that these meetings occur more regularly for the purpose of dealing with interpersonal relations as well as to develop a problem-solving and planning culture.

Creation of a Second Autonomous Section

In August 1974 management was planning to create a fourth operating face

section. Such planning had not yet begun in the summer of 1973, when the steering committee was developing the conditions for undertaking the original experiment. The question now arose as to whether this new section should be started as a conventional or as an autonomous section. The research team was accumulating evidence that weighed in favor of choosing the latter alternative. There were signs that many members of management were hostile to the experiment and related to section members with indifference or disdain. Such behavior resulted in part from the fact that section members began to initiate requests for more effective scheduling of supplies, tools, maintenance, etc. This reversal of the direction in which initiatives for action had flowed was in sharp contrast to previous management practice and produced hostile reactions among those middle-level managers to whom such flows were directed.

The research team believed that unless undeniable improvements in performance resulted, management would probably reject the experiment at the end of the experimental year. Such improvement was unlikely unless they could develop a philosophy and style of management that were compatible with autonomous group working. The likelihood was remote that they would make a commitment to adopting such a philosophy and style when there was only one autonomous section to deal with. The introduction of a second autonomous section was considered an event of sufficient significance to "unfreeze" the mine's social system and establish a new direction for learning.

The union members of the steering committee requested a local union vote on creating a second autonomous section. A "special" meeting was convened in September and was attended by 17 of the 27 members of the autonomous section. The composition of the group attending was highly atypical, as it included many members of the autonomous section who had

not been to a local union meeting in years and excluded many of those who attend regularly scheduled meetings held at the beginning of each month. This unusual turnout of autonomous section members underscores the concern they felt about the future of the project. The local members voted affirmatively (26 to 5) and the second autonomous section began operations in October. The immediate reaction of the original autonomous section members confirmed the research team's view that an "encapsulation" and "rejection" process had been developing among middle management. Until this time many section members expressed the view that management would soon terminate the project and had felt tentative in their commitment to an endeavor that appeared destined to have a short life. The introduction of the second section produced a resurgence of enthusiasm among the original autonomous section members and a will to make the experiment a success. It was also at this time that the management meetings referred to in the previous section began to take place.

Report to the Steering Committee

The research team presented a report to the steering committee in March 1975 in which the actions undertaken over the previous year were summarized and preliminary results presented. The separately funded evaluation team independently collected data for a more systematic analysis, but such results would not be available for some time (see Goodman, 1979).

Comparisons

The second autonomous section, having commenced in October 1974, had not been in operation for a sufficient period of time by March 1975 to provide any useful data. The

last three months of 1974 included a month-long national strike and several holidays. Furthermore, caution is advised in comparing the autonomous section with the two remaining nonautonomous sections operating at the beginning of the experimental year. Direct comparisons are difficult because, for example, Nonautonomous section A had better conditions for most of 1974 than did the autonomous section as well as more "backup" equipment, making delays less frequent and prolonged. By contrast, Nonautonomous section B had a great deal of water and generally poor physical conditions throughout 1974. Nonautonomous A had four "ram cars" compared to two "shuttle cars" on Autonomous A. Ram cars, being battery operated, carry their power supply with them. Shuttle cars, connected by cables to a central power station, must be operated more carefully and, at times, more slowly to prevent the tangling, running over and damaging of cables.

Data for 1973 are presented for suggestive purposes only, because any comparisons with 1974 must be interpreted very cautiously, as the composition of the crews on each section changed when the experimental section was created. Furthermore, in a small mine, it was virtually impossible to "seal off" interaction between personnel of the various sections. For example, autonomous section foremen told the other foremen of their activities and training experiences, which some of the latter began to adopt on their own. All miners belong to the same local union and share their experiences at union meetings and at shift changes. Also, training and development activities for middle and upper management personnel who make minewide decisions were bound to have an impact across all three mining sections.

The research team has considered the mine as a whole as the proper unit of analysis, recognizing that "contamination" effects themselves are important data in their own

right. Progress on the autonomous section would have to be measured in a longitudinal record of the section against its own past performance. This would show its capacity to learn. Comparisons with other sections have restricted use, though they can be illuminating. All numbers in the tables below are to be treated as descriptive statements. No attempts are made in terms of analytical statistics to infer what might be generalizable to other mines or to form a reliable basis for prediction.

Health and Safety Violations

Table 1 shows federal violations assessed against each of the three sections for 1973 and 1974. The reduction in violations for the autonomous section is quite dramatic. This reduction, to about half the number in 1973, occurred in spite of an overall increase in violations for the mine as a whole. The increased number of violations on the other two sections can be attributed to the increased number of visits by federal inspectors to the mine, especially following a fatal accident on Nonautonomous section A in September. The autonomous section had fewer violations in 1974 even with more visits by federal inspectors.

Accidents

The figures in Table 2 are for all reported accidents and those that were lost-time accidents. The total reported accident rate and the lost-time accident rate for the autonomous section are superior to those of the other two sections for 1974. The fact that the autonomous section had eight members, compared to six members on the other two sections, works slightly to the former's disadvantage in such comparisons. The higher incidence of reported accidents for

the mine as a whole in 1974 may be due in part to more stringent reporting requirements requested during the year by governmental agencies. Minor accidents such as cut fingers, bruises, etc., were not reported in 1973. The research team also was informed that conditions in the mine were generally more difficult in 1974 than 1973. If so, the lower overall incidence of reported accidents on the autonomous section is impressive, as this section maintained its overall 1973 record, while that on the other sections increased.

Absences

Table 3 shows the number of absences (excused and unexcused) for each section in 1974. Because of the changes in section membership resulting from the experiment, the research team decided not to compare 1974 absenteeism data with 1973 data. The assumption of similar worker performance tht was applied when comparing sections on other performance measures did not apply in this case, as only a few individuals contribute to most of the absenteeism. The evaluation team is expected to compile data that adjust for such changes in membership between sections.

The rates of absenteeism on all sections are low for the mining industry--those for the autonomous and Nonautonomous B sections being exceptionally low. The 1974 national average was 12.8 percent of man-days worked. There is no obvious explanation why Nonautonomous B had a consistently low absentee rate. This section experienced particularly

Table 1

Federal Violations, 1973 and 1974

	Autonomous	Nonautonomous A	Nonautonomous B	Total
1973	18	19	10	47
1974	7	37	17	61

Table 2

Total Reported Accidents and Lost-Time Accidents, 1973 and 1974

	Autonomous	Nonautonomous A	Nonautonomous B	Total
1973				
Reported	6	5	4	15
Lost-time	2	3	2	7
1974				
Reported	7	14	11	32
Lost-time	1	3	2	6

bad conditions in 1974 and it might be that under such conditions the crew members did not want to let each other down; they share the bad as a way of enduring it and, of course, in so doing create safer conditions for themselves. For more positive reasons, also, the members of the autonomous section appear not to want to let each other down.

Table 3

Absenteeism by Sections, 1974

	Autonomous	Nonautonomous A	Nonautonomous B
Average crew size	(8)	(6.1)	(6.3)
Total man-days absent	135	187	112
Percentage absent per man-day	2.5	4.4	2.4

Costs

On the experimental section it was expected that a more positive attitude would mean that men would be less wasteful of supplies and take better care of equipment. As learning proceeded, the costs of supplies and maintenance should decrease. Table 4 shows direct inside costs (production and maintenance) per ton per quarter of 1974 for each of the three sections. (The whole cost of new equipment parts was charged to the autonomous section in the first quarter and to Nonautonomous A in the fourth quarter. This exaggerates the costs to these sections in these quarters.)

A number of factors must be taken into consideration before a final determination of actual costs is made. There was substantial inflation in the costs of some supplies, e.g., roof bolts, for which corrections must be calculated. Also, the type of mining that predominated throughout the year on each section must be controlled for. For example, fewer supplies are

generally used for pillar work than for development. However, these corrections are unlikely to alter the basic differences in trends even after a discount is made for the first quarter. The autonomous section shows a downward trend, while this is not the case for the other two sections. This pattern appears to have been maintained early in 1975. January 1975 figures show costs on the autonomous section at $1.16 per ton compared to $1.85 on Nonautonomous A and $2.75 on Nonautonomous B.

Table 4

Direct Inside Production and Maintenance Costs per Ton, 1974

	Autonomous	Nonautonomous A	Nonautonomous B
First quarter*	$ 1.58	$ .84	$ 1.56
Second quarter	1.40	1.12	1.73
Third quarter	1.24	1.05	1.38
Fourth quarter	1.13	3.56	1.41

(*) First quarter figures on all sections exclude January. Costs not calculated by Sections until February 1974

Productivity

In the March 1975 report, the research team was not willing to state conclusively that the autonomous section showed higher productivity than the other two sections if comparisons were made between calendar years 1973 and 1974, though there was a management impression that it did so towards the end of 1974. At that time, the only statement that could be made with assurance was that production had not decreased as a consequence of the program's

introduction, nor as a cost of improving the safety level. It is a currently accepted belief in the coal industry that one of these goals--production or safety--must be sacrificed for the other.

The research team previously presented a field theoretical analysis of the social and technical forces that facilitated or inhibited productivity in the autonomous section (Trist, et al., 1977). This analysis suggested that productivity in the autonomous section was inhibited for several months because members of the section were concerned that the experiment might end before completion of the one-year trial period. They had to deal with the hostilities of middle management, the derision of several members of other sections who saw in the new way of working a questioning of the value of their experience and skill (the epithet most frequently hurled in a sarcastic tone to autonomous section members was "Hey, superminer") and, finally and perhaps most importantly, they had to deal with the internal doubt and anxiety that are associated with being the sole carriers of an innovation.

The creation of the second autonomous section (B) reduced the strength of these inhibiting forces. During the last quarter of 1974 and the first nine months of 1975, Autonomous A was the highest producer among the four operating sections. With the exception of the months of March and April, the newly created Autonomous B was the second highest producer in the first nine months of 1975. Autonomous B may have performed so well because it did not have to carry the burden of innovation as did the first autonomous section, with all the inhibiting forces this created for it. The second section could mobilize its energies immediately toward improving production and safety. Autonomous B began operations with fewer experienced men than did Autonomous A. Virtually all the members of Autonomous A were very experienced miners. Autonomous B had a "core" of experienced miners doing face work, support work being done by

men with very little mining experience. The inexperienced miners were thus deployed in a manner to minimize any negative effect they might have had on production and yet to provide them with a very effective means to learn about face work. They substituted for face workers who were absent and supplemented at the face when they could be helpful. The research team and several members of management noted that members of the second autonomous section seemed to adapt more rapidly than the first section to the new way of working, e.g., switching jobs, helping each other, etc. Section productivity is compared in Table 5.

Table 5

Tons of Clean Coal Produced per Day

	Autonomous A	Nonautonomous A	Nonautonomous B	Autonomous B
1974	756.3	805.8	562.2	449.3
1975	701.2	618.5	619.4	650.4
Critical period (Dec. 1974 - Sept. 1975)	738.0	591.0	612.0	651.0

The critical period for comparing production between sections begins in December 1974 after the month-long national strike and after state mine officials required all four sections in the mine to adopt a more complicated and time-consuming timbering plan following the fatality in Nonautonomous A the previous September. The change contributes to

the overall lower production totals in 1975 as compared to 1974.

Another factor that may have contributed to lower 1975 totals, although its effect probably began some time in 1974, was the systematic effort by management to reduce "ghost coal." Ghost coal is the difference between the amount of coal that is measured on the surface coal pile compared with that recorded in the foremen's daily records (it has been as high as 20 to 25 percent of total production). The system of monitoring and rewarding (or criticizing) performance by foreman rather than by section encourages ghost coal, as the foremen stand a good chance of appearing to produce more than they actually do with a low probability of the discrepancy being traced directly to them (it can generally be traced to the section). One by-product of the experiment has been more accurate measurement of tonnage through more frequent visits by surveyors who measure cubic feet of coal extracted to cross-check foreman reports. Management reported an overall decrease in ghost coal after 1973. More than once, Autonomous A has been "right on the nose" in their monthly tonnage figures, while other sections have not. Efforts to persuade management to emphasize section performance were only partially successful before 1976 but, until then, foreman performance received more emphasis on the two nonautonomous sections than on the two autonomous ones. Such organizational practices may have worked to the disadvantage of the autonomous sections in productivity comparisons between 1973 and 1975.

Corrected for days in which sections (all three shifts) spent the entire day in the classroom, Autonomous A produced 25 percent more coal than Nonautonomous A (738 tons per day vs. 591 tons per day) and 21 percent more coal than Nonautonomous B (738 tons per day vs. 612 tons per day). Autonomous B was the second-highest producer in the mine (651 tons per

day) during the same time period, December 1974 to September 1975. In spite of the constraints imposed on all four sections by the introduction of a more difficult (and safer) timbering plan, Autonomous A was much more able to maintain its former productivity level than was Nonautonomous A. Autonomous A's production dropped 2.4 percent after introduction of the new timbering plan compared with a drop of 26.6 percent on Nonautonomous A (see special case for Nonautonomous B in next paragraph). Trist, et al. (1963) and Herbst (1962) offer evidence that autonomous work groups can adapt more readily to the introduction of such task constraints and to "disturbances" in general through their superior capability to deploy flexibly their human and technical resources.

It is difficult to dismiss these results as solely an artifact of changing physical conditions, for Autonomous A produced more coal each and every month for 10 months, during which all phases of mining should have been "evened out" between sections. More particularly, this would be the case between Autonomous A and Nonautonomous A (some minor correction for seam height may be required) than between the former and Nonautonomous B, although conditions on the latter were considerably better during the 10 months under consideration than they were in 1974. Furthermore, Nonautonomous A had four ram cars vs. Autonomous A's two shuttle cars (in order to run three ram cars, one of the mechanics or general underground crew members filled in as an "unofficial" seventh face-crew member; the fourth ram car functioned as a backup resource to minimize delay time); Nonautonomous A had five full-time mechanics vs. three mechanics on Autonomous A. Additionally, there were six belts between the surface and Autonomous A's face belt compared to three belts for Nonautonomous A. While the former was directly responsible for only the two belts closest to the face, there were still six potential

sources of delay compared to three such sources on Nonautonomous A. One would reasonably expect Nonautonomous A to produce more coal than Autonomous A, considering all of the former's resource advantages. This would not be so in comparing Autonomous A to Nonautonomous B, which was prevented from doing any pillaring work (a considerably more productive phase of mining) because of bad physical conditions and because of restrictions imposed by federal and state safety laws.

Most members of management considered Nonautonomous A as the section against which to test the merits of the innovation. Progress on Autonomous A could hardly be mentioned without someone comparing its production to that of Nonautonomous A. One foreman on Nonautonomous A considered the introduction of the experimental section to be "throwing down the gauntlet," saying, "I'll be damned if I'll let (Autonomous A) beat us!"

The 10 month pattern ended one month after the local union voted in August 1975 to reject the document the steering committee had developed. By the end of September, three men had bid out of Autonomous A and several others on both autonomous sections were attempting to do the same. This was due to uncertainty over whether support men and shuttle-car operators on the two autonomous sections would return permanently to contract pay rates (they were paid contract rates from August 25 to September 29, when postvote initiatives went into effect.) Several support men and several shuttle-car operators (mostly on Autonomous A) were now qualified by training to perform jobs paying top rates but their contract job classification pay rate was lower than what they had been earning in the autonomous sections. The performance of Autonomous A, hampered by a partially reconstituted membership and by difficult physical conditions, became progressively poorer. In December, it was the lowest producer among the

four operating sections. The decreased productivity among members of both autonomous sections, but in particular Autonomous A, can be partly explained as a reconfiguration of field forces, a weakening of facilitating forces and strengthening of inhibiting ones. However, this does not convey the shattering of morale and the depth of disappointment expressed to the research team by members of the autonomous section following the negative August vote.

Attitudes

The evaluation team interviewed all the men working at the mine in December 1973, and again in June and October 1974. Preliminary data from the experimental section suggest that the following changes have taken place. The men

- perceive themselves as making more decisions concerning how the work is divided, what they should do, and how to do it;
- recognize the interdependence they have with each other and believe that their coworkers have many good ideas to contribute to improved performance;
- see their supervisors as making fewer decisions affecting how they should perform their work.

In September 1974, members of the experimental section had a private meeting with officers of the international and district unions. The latter reported what they had been told to a meeting of the steering committee. The men had said they felt themselves respected by management as never before. They no longer felt tired when they got home from work. There was no longer the same stress, as the bosses were off their backs. They did not quarrel as much and did not leave things in a mess for the next shift.

Representatives of the section reported these attitudes publicly when they were on the same panel with management at conferences on work quality at Cleveland, Ohio, Buffalo, New York; and Washington, DC. The effects on audiences of some 100 people (managers, trade union officials from many industries and key staff from federal and state agencies) were very great.

Extending Autonomy to the Mine as a Whole: April to August 1975

The steering committee was pleased with the results reported above and was interested in expanding the experiment to the mine as a whole. Initial plans were for a different area of the mine to begin an orientation and training period every three months until all areas worked under autonomous conditions. However, the local union, realizing that the initial experimental year was drawing to a close, passed a motion at its March meeting calling for the entire mine to become autonomous at once or to drop the program completely. A number of union members considered it unacceptable for some areas of the mine to receive the program's benefits and privileges while others did not. Conversations with union members suggested that the vote did not so much reflect an understanding of the concept of autonomous working and a desire to try it as an attempt to reestablish equity within the mine, one way or the other. The company president was unwilling to accept the "at once" proposal, as he did not believe he had the management and training resources to carry out such massive change instantly. However, he was willing to discuss new alternatives with the union members of the steering committee. The steering committee, as a whole, subsequently decided that the proper way to proceed was to write a new document in which provisions would be developed for implementing autonomy in all areas

of the mine. The local union accepted this procedure at its May meeting on the condition that the document be submitted to a union vote no later than the end of the summer vacation period in early August.

Although the steering committee would actually write the document in conjunction with the research team, procedures were planned for consultation with all members of the work force. Consequently, two rounds of three-hour meetings were held in May and June, each consisting of some 30-40 workers drawn from each area of the mine (four face sections, general underground, maintenance, surface, and preparation plant). At these meetings, members of management and the research team were present. Suggestions were offered by the workers and most were incorporated into the document. As the document neared completion, at the suggestion of the steering committee management agreed to allow the union members of the steering committee to meet alone on company time with each of the areas of the mine. The men had been somewhat inhibited in the presence of management and the research team. Such meetings took place during July and early August. During this time, district and international representatives of the UMWA attended meetings of the steering committee and contributed provisions to the document. Such representatives also attended a local union meeting in August and endorsed the principles of autonomous working. In mid-August, the document was placed before the local union membership for vote by secret ballot. The document failed to pass by a vote of 79 to 75. There was enormous confusion about the meeting as regards time and need for attendance. But the union would not hold a second ballot.

Reasons for a Negative Union Vote

Traditionally, a no-vote could be taken as a signal of the end of the experiment; that is, the no-vote was the outcome. However, in the view of the research team the vote was an event embedded in a process that could still be influenced, if the event itself were properly understood in terms of what yes-votes or no-votes meant to those who cast them. The steering committee, believing that the concept of autonomous working was too attractive to abandon easily and encouraged by the initial results, met during September and October to analyze the reasons why the vote went the way it did. After thorough discussions among themselves and with a large number of individuals in the work force, the steering committee found the following reasons for many of the no-votes cast. They can be grouped into four basic categories.

Perceived Inequities

The document upon which the union members voted provided that all who wished to participate in the program could earn the top rate within their respective areas of the mine for 90 man-production days (about four months). At the end of this period, a qualification committee made up of various management personnel would determine whether an individual had satisfactorily learned the job or jobs that the document had outlined for earning the top rate. (The union did not wish to participate in these assessments. If it had, the members of the mine committee would be placed in a "double bind," as they might have to present a grievance on behalf of a worker who was dissatisfied with a decision concerning his qualifications for a bidded job.) Several members perceived these provisions as inequitable because some members of the experimental groups received higher than contract rates for their job classifications for an entire year without having to demonstrate qualifications to a committee. Additionally, the prospect of

taking any kind of test was threatening to some of the older workers and perceived as "undignifying" to many who felt that working in the mines for 20 to 40 years in some cases was qualification enough. The steering committee members stated in several of the communication meetings held before the vote that 90 percent of the men were already judged by a joint management-research team survey to be qualified for the jobs in question as based on observation over several years and that no tests were required of them. Of the remainder, most were expected to pass within the training period; a very few would be safety risks--this was public knowledge. The qualification provisions were to be applied mainly to new workers hired in the future. This point was not widely understood in spite of several efforts to clarify it. Feelings of inequity and of threat were too powerful for it to be heard.

A second issue arose among surface workers who disliked the document's provisions that excluded them from trading jobs with workers in the preparation plant. One of the jobs in the preparation plant paid a higher pay rate than any jobs that could be learned within the surface area.

A third source of perceived inequity demonstrates all too well that a planned intervention into a social process may produce unintended consequences. When the steering committee approved of the idea to start the fourth operating section as an autonomous one, it saw no reason at that time to discontinue the policy of paying all who volunteered to work on an autonomous section the top rate for face work. This was believed to be justified because all members of the first autonomous section were requested to perform or to learn to perform all of the jobs on the section, some of which normally paid the top rate. The common top rate for all would weaken the present "one man/one job" thinking that was prevalent and strengthen each

member's identity with the primary task of the group as a whole. It was anticipated that senior, well-experienced miners would be the ones to bid into the new autonomous section, as had been the case with the first section.

In the event, only a limited number of the senior and experienced miners bid into the new section, because they had already established personal relationships in their present crews with their buddies and/or their foremen and didn't wish to sacrifice this for the uncertainties of working with new men and a new foreman under unfamiliar conditions. This was especially so on the section that had developed a tight in-group mentality through having had to face prolonged bad conditions. Two of the three foremen chose to go to the new autonomous section, partly to escape the bad physical conditions on the old section. Though abandoned, their crew members (with more years of mining experience than the mine average) stayed where they were. Several of the men on the third crew had signed the bid sheet to go to the new section but withdrew their names when they heard that their foreman would refuse to go with them. The unanticipated result was that many jobs on the new section were filled by apprentices with little more than 90 days of mining experience, who otherwise would have been outbid by more senior, qualified men. The inequity created by "green" miners receiving higher pay than some men with many years of experience outraged the sense of distributive justice of, perhaps, the majority of those outside the two autonomous sections, especially those on the other two face sections.

Changes in the National Contract

The national contract negotiated in late 1974 between the UMWA and the

Bituminous Coal Operators Association (BCOA) altered the distribution of pay grades among underground face workers. In contrast to the 1971 contract in effect when the experiment began, roof bolters and miner helpers as well as miner operators and mechanics were now to receive the top rate paid for underground face working ($55.00 per day in the first year of a three-year contract). This contract change shifted the distribution of those men who would now earn the top rate according to their present job classification regardless of whether they participated in the autonomous program or not. Of the 54 workers in the two autonomous sections, 30 men now earned the top rate; that is, 56 percent of the workers on the two sections. On the other two sections with only 21 workers in each of the two sections (in the conventional manning pattern they did not have their own support men), 30 out of a total of 42, also earned the top rate; that is, 71 percent of the workers on these two sections. It is believed that this distribution shift influenced the August vote as some of the workers (particularly those in the two nonautonomous sections where no firsthand knowledge of the program existed) felt they had nothing to gain by voting "yes." More workers were now in a position of consolidating gains made through the national contract, and some expressed hostility toward those who could earn more money without having to "do it the hard way."

"Union Busting" Fears

Quite a number of union members, including some of the most influential older workers, expressed the view that the autonomous experiment was a plot to break the local union. Despite the fact that most of the workers knew that the experiment in autonomous working was jointly initiated by the union and management and that several international and district officers had

endorsed the program, historical factors undoubtedly contributed to the fears expressed. First, the mine is located in a region of Central Pennsylvania where the percentage of unionized mines is low and where several local coal managements were known to have attempted to blunt union organizing efforts by paying wages above the contract level. Credence was added to the belief that the experiment was an antiunion tactic by the fact that the program permitted some of the workers to earn higher pay than was provided by the national contract.

A second factor was that the current company president had bitterly opposed the successful union organizing effort that had taken place at the mine nearly a decade earlier. Many of the older miners had taken part in the organizing effort and had little faith that the company president had altered his position on unions. This was the case despite the fact that the president had publicly stated on repeated occasions that he now accepted the legitimacy of unions--otherwise he would not have accepted a joint labor-management committee--and that he did not oppose and, in fact, encouraged a union organizing effort at a new mine that he owned. Also, he no longer owned the mine under discussion, having sold it to a large public utility that had a good reputation for industrial relations.

A third factor was the knowledge among some workers that a mine in West Virginia had considered undertaking the same experiment as Rushton but had voted not to do so. It was widely explained that the vote at that mine had nothing to do with evaluation of the merits of autonomous work, but suspicions were aroused among many. Considering these circumstances, it is indeed difficult for members of a small local union at a relatively small mine in a relatively isolated region to carry such a burden of innovation by itself.

Resentment Aroused by Privileges

Enjoyed by Autonomous Section Members

The proper unit of analysis in any effort at organizational change ought to contain those subunits that are either socially or technically affected by the change effort, in this case, the mine as a whole. The tactical considerations for beginning the experiment in one and subsequently two sections of the mine have already been discussed. Whether or not these tactics were the most feasible at the time can be debated. The research team believed that they were; the likelihood that the privileges enjoyed by the autonomous section members would be resented by members of other sections was anticipated, but not the strength or pervasiveness of these feelings.

Apart from the fact that all members of the autonomous sections were on the top rate, feelings of envy were aggravated by some of the following events or practices:

> Members of nonautonomous sections greatly resented the absence of members of one or the other autonomous section on Sunday midnight shifts. The latter, when scheduled for Sunday midnight work, stayed home from work until Monday mornings to attend day-long section conferences.
>
> Trips taken by autonomous section members to appear on panels at several conferences were resented.
>
> Some members of the autonomous sections displayed elitist attitudes toward other

workers in the mine due to the additional technical training the experiment had offered them.

Foremen and members of the nonautonomous sections resented the additional manpower resources provided to the autonomous sections in the form of two additional support men per shift. Each of the other two sections had two support men on the day shift only, but additional personnel were available to them on request as they were needed.

Resentment over the latter was exacerbated when management made comparisons between sections on productivity, accidents, violations, etc. Such comparisons were judged as unfair by nonautonomous section members, because they had less control over their manpower and fewer training opportunities. Expression of sentiments over matters such as these was given wide circulation by some foremen on the nonautonomous sections and certain members of middle management who, before the vote, campaigned against extending autonomous working to other areas of the mine.

Initiatives After the Postvote Analysis: September to December 1975

The president of the company felt sufficient commitment to the values supporting greater decision-making opportunities for workers as well as sufficient encouragement from the initial results to make provisions for going ahead, subject to any limitations arising as a

consequence of the negative union vote. He considered it a management prerogative to train his own managers in a style compatible with allowing workers greater participation in decision making. The 1974 national contract had already obligated management to provide more training to workers than any previous contract had required. However, the president did not perceive this obligation as a "concession" to the union but considered training as the most effective means to increase both productivity and safety. There were also no provisions in the contract prohibiting management from paying workers above the contract pay rate for any job classification, provided that the means for doing so did not discriminate against anyone who currently held that job classification.

As a result of the negative vote and the subsequent analysis by the steering committee that took the president's views into account, the initial experiment was declared terminated. The steering committee was abolished as the primary function mandated to it by the original document of October 1973 was to monitor and evaluate the original experiment. However, before taking such action, the steering committee sought guidance from the 1974 national contract to see if it provided for the legitimate existence of a forum within which both labor and management could discuss matters of mutual interest. One particular section of the contract provides that "Appropriate local and district officers of the union (including the Mine Health and Safety Committee) shall have the opportunity to review each training program and make comments and suggestions prior to its implementation." Accordingly, the union officers and management agreed to create a training and development committee to guide the training efforts to be undertaken within the mine.

The president of the company agreed to accept the principle of equity affirmed by

the local union officers that members of all other areas of the mine be given the same provisions for training and the same time period for qualification as offered to the original two autonomous sections; that is, the top rate within their respective areas of the mine without having to take any qualification tests for a period of one year. The president accepted this principle for reestablishing equity among areas of the mine, but on the condition that all who receive these benefits should demonstrate good faith by making an effort to learn new jobs (by switching jobs, etc.) within the next 60 working days, and that the provision not apply to anyone who started working at the mine after October 1975, unless he qualified for top-rate pay by previous experience and qualification. All new, inexperienced "hires" would have to be qualified by management after learning one of the jobs already paying the top rate or by learning a combination of jobs deemed deserving of top-rate pay.

The decision was made to begin orientation and training periods immediately for all areas of the mine. Instead of the "massed" six-session training period provided to the original autonomous sections, the six remaining areas of the mine would rotate their classroom sessions between them (one session per area every six weeks). Plans also were made to begin a six-session management training program in January 1976 that would include management personnel from every level and area of the mine. Each session would be for the entire day on alternate Saturdays.

By December 1975, sentiments and beliefs had changed sufficiently for the local union to vote to allow its officers to sit down again with management and develop a new document which would be submitted to the membership for a vote. New proposals were developed to deal with the imbalance that had emerged after the introduction of the second

autonomous section. It was no longer considered appropriate, however, to develop a comprehensive document for minewide autonomy, as had been done in response to the local union's "all or nothing" resolution. A comprehensive document offering a complete program was too complex and confusing for those who did not participate in writing it. This, no doubt, contributed to misunderstandings concerning specific provisions of the rejected document. It appeared that there was more merit in presenting proposals for innovation serially. Before any votes could take place, however, the union president was voted out of office by a candidate who opposed any further discussion with management about revival of the program. The research team stopped visiting the mine shortly after this but stayed in touch with some union members and managers on a periodic basis.

Rushton Revisited: April 1989

The first author invited seven participants in the original experiment to a luncheon meeting in April 1989. Three of the men had recently retired. Three of the remaining four held management positions. These men could provide information on developments at the mine over the past twelve years and offer clues to any lasting effects the experiment had on mine management and on the miners who worked in the autonomous sections. They also could provide explanations for any decline of autonomous practices over the intervening years.

The opportunities for learning provided to members of the autonomous sections had produced a "flowering" of talent and initiative. Among the members of the two autonomous sections, four became foremen and a fifth became a shift foreman. Four became local union officers; one became the president and the other three became members of the Health and Safety

Committee. One of the original foremen is now the safety director, and another is a shift foreman.

These men continued their autonomous practices long after the experiment ended and had tried to influence newcomers to work in a similar way. They believed that everyone who participated in the experiment retained a favorable view of it. One man recalled that foremen did not have to tell members of an autonomous section what to do and that many knew more about mining practices and state and federal mining regulations than the foremen did. Another man said that his crew continued to work autonomously as long as it remained intact. He found it difficult to explain to replacement workers what autonomous work meant but had tried to demonstrate it by example.

The mining industry has been in a recession since oil prices declined dramatically in the early 1980s. As a result, several mines in the area have closed and total employment has shrunk. Rushton remains open even though the public utility that owns it has closed several other mines. Rushton has survived because of its relative efficiency. Its future remains uncertain, however, because underground coal costs more than twice as much to mine as strip mine coal. A sizable percentage of the coal that Rushton ships each month to electric generating stations is "pass-through" coal that Rushton purchases from local strip mines. Nevertheless, Rushton's owners recently invested in modernizing its mining equipment and have plans for opening two new working sections.

Rushton now employs 210 people compared to 250 in the mid-1970s. Many of the middle-aged miners who were at Rushton in the mid-1970s have since retired. Most of the replacements have been drawn from the mines closed by Rushton's owners. By contractual

agreement, these workers were given hiring priority at Rushton. These mines were geographically close to the steel industry, which has a strong craft orientation and identity with specific job classifications. Newcomers with this orientation resisted multiskilled work and job rotation.

The men at the luncheon credited the autonomous program for contributing to the exceptionally favorable labor relations climate at Rushton. The union leadership is more stable now than it was in the mid-1970s. The grievance procedure is followed consistently. No wildcat strikes have occurred at the mine for several years. Some people had feared that Rushton's good labor relations would deteriorate with the influx of workers from mines with labor relations that were poorer but more typical for the industry. Apparently the opposite occurred. The men reported that Rushton's good climate "rubbed off" on the new workers. They also reported that these newcomers had heard before they were hired that there was "something special about Rushton as a place to work."

Senior mine management has changed considerably in the last 12 years. The men at the luncheon viewed the new mine manager as more participative and more cooperative. One man said he was "one hundred percent behind safety." Unlike his predecessor, the new mine manager meets weekly with all of his key subordinates and monthly with the chairmen of the union's Mine and Health and Safety Committees. The men thought that the mine manager would support a new autonomous work program if he were approached about it. However, they viewed his immediate subordinate, the mine superintendent, as "more hard-line" and "quicker to react." Senior management also included former section and shift foremen who had opposed the program in 1975.

The mining technology at Rushton has changed dramatically since the mid-1970s. Three of the sections use rip head miners, which are much more productive than those used previously. A new type of lighting equipment on the miners makes the section "as bright as an office." A working face can be advanced by 30 feet before bolting is required. By agreement between the government, union and management, temporary support timber no longer has to be set. Twin boom bolters can drill two holes and place two bolts simultaneously. As a result, approximately 1,000 tons of coal per shift can be mined, much more than the productivity of the 1970s. By contrast, the support work required outside the immediate work face remains fairly labor intensive and slow, i.e., laying track and wire, building brattices, etc. As a consequence, it is very difficult for support work to keep up with the rapid extraction of coal. As the mine currently is not permitted to remove pillars, there is no temporary halt in advance work that would permit support crews to catch up.

At the time of our experiment the national average for coal production was 350 to 400 tons per day. In Rushton, that for the poorest nonautonomous section was over 500, suggesting that Rushton was among the better producing mines. Autonomous A averaged over 700 tons. This suggests that the discrepancy between what the more powerful continuous miner and the rest of the system can do is even greater in 1990 than in the mid-1970s. Productivity is still thought of in terms of the machine rather than the system of which it is a part.

Rushton still has four operating sections, but now two additional "reserve" sections with mining equipment in them are used when one of the four regular sections breaks down. The face crews move to a reserve section while equipment in their regular section is being repaired. One consequence of this practice is that crew members have no sense of ownership in

the reserve sections or in their regular sections. Cleanup and rock-dusting tends to be poor. It may be hazardous for crews to work in a section that another crew has worked in previously or that has been left unattended for some time.

The retreat from self-containment of skills within work groups is nearly complete. The section foreman's responsibilities now end at the feeder. A central support group is assigned all tasks beyond the feeder, e.g., move power, lay track, wire, etc. It appears, however, that the support group is overwhelmed by more work than it can handle. The differential rate of productivity growth for coal extraction versus support work has been cited already. The new system for directing air to and from the sections has doubled the number of brattices that must be built for a given amount of coal extraction. Support personnel often are "borrowed" by section foremen who now only have one support person on their crews. The sections are supposed to get a substitute worker from the general crew to fill in for absentees, but this does not always happen. The support person on the second and third shifts builds brattices almost exclusively. Overtime work usually is required to maintain the pace of advances at the face.

Technological change and the retreat from self-containment and multiskilled work have shifted the burden of making manpower and resource deployment decisions from crew members and their section foreman to the shift foreman. Theoretically, the new technology and curtailment of the crew's territorial responsibility should lead to the transfer of workers from the face to support work. The men at the luncheon said that this might have happened if the crew members were still multiskilled. Only a marginal reduction has occurred, however, because most face crew members are not willing to perform tasks that fall outside their regular job classifications. These men also thought that moving crew members and foremen between

reserve and regular sections diminished their familiarity with current conditions in either section and impaired their ability to make effective decisions.

These organizational arrangements explain why the men at the luncheon viewed Rushton as being "shorthanded" in spite of substantial increases in productivity and why senior management believes that those currently working cannot be spared for more than the minimum of eight hours of training per year required by the BCOA/UMWA contract. The lack of training contributed to the deterioration of the system of paying top rate to any miner who learned all jobs at the face. This provision remained in place until the mid-1980s, but was dropped after many miners who had qualified for the top rate refused to switch jobs with others. The men at the luncheon said that those miners "just saw it as an easy way to the high rate." The minimum time in the classroom precluded any opportunity to sanction the values or practices of multiskilled work.

Compensation both for workers and managers has improved considerably over the past 12 years. For example, the average miner is paid $128 per day under the current BCOA/UMWA contract or approximately $35,000 per year if overtime pay is included. The basis for calculating bonuses for managers, however, impairs cross-shift cooperation. The bonuses, which can exceed $4,000 per year, are calculated on the basis of productivity per shift (with a penalty for citations and accidents). This practice strongly reinforces the shift mentality that the research team tried hard to discourage during the experiment.

Reflections

Twelve years is more than adequate time to acquire perspective on the Rushton

experiment and to understand better why it failed to serve as a model for diffusion to the mine as a whole. Some of the reasons were related to major contextual changes in the mining industry in the mid-1970s. Other reasons were related to the actions of the research team, either resulting from its own judgment or from acquiescing to conditions set by the agencies that funded the experiment.

The contextual factors that made the Rushton experiment possible in the first place began to deteriorate soon after the experiment began. Support at the national level from the UMWA became virtually nonexistent after Arnold Miller was politically weakened following negotiation of the 1974 national contract. This contract was initially rejected by the UMWA International Board, but eventually ratified narrowly by the union membership. The extreme bimodality in the age distribution of union members in the mid-1970s contributed to the narrow ratification. Older workers wanted better retirement provisions, and younger workers wanted larger pay increases. The contract satisfied neither.

The union membership had been enfranchised only recently to ratify the contracts that its officers negotiated. This, perhaps, contributed to rising expectations among union workers and to testing their new political strength. Wildcat strikes increased in frequency every year throughout the 1970s, reaching a peak during negotiation of the 1979 contract. The unsettled state of labor relations in the industry was reflected in relations between Rushton management and workers during and following the experiment. Several wildcats strikes occurred immediately after the vote, ostensibly on issues that were unrelated to the experiment. This may have been an unconscious way of reestablishing union solidarity that had eroded seriously during the experiment.

Other contextual changes affected support for the experiment. For example, Warren Hinks and a partner had held a substantial equity position in Rushton when the experiment began. They sold their interest shortly afterward to the large public utility that owned the remaining interest. Rushton management at all levels was uncertain about Hinks remaining president or the public utility becoming more directly involved in management of the mine. Although Hinks remained president until 1981, his role in daily decision making decreased, while that of the public utility increased. Those managers who supported Hinks' vision of autonomous work grew less confident of seeing it realized, while those who did not support it grew more confident that they could persist in managing as they wished without fear of disciplinary action.

The experimental paradigm set by the funding agencies as a condition for receipt of funds seriously hampered the research team's effectiveness and unleashed some of the dynamics that eventually led to the negative union vote. The experiment consisted of designating some sections of the mine as control groups to be compared to the experimental group on performance at the end of one year. The research team had reservations from the start about the scientific merits of using this method in this setting, believing that one part of a small mine with a highly interdependent work force could not be sealed off from the "contaminating effects" of another part. They permitted its use as a concession for funding, but underestimated the intensity of the social and psychological dynamics that would be released by its use. The envy, anger and rivalry generated between the autonomous sections and the rest of the mine soon overshadowed the search for a better way to work and a better future.

The research team unwittingly contributed to intensifying the negative feelings

generated between parts of the mine when it supported the initiation of the second autonomous section. The rationale for support was to avoid the encapsulation and rejection process that often accompanies small demonstration projects undertaken within a larger organization. An unanticipated consequence of the initiation of the second autonomous section was that many relatively inexperienced miners were able to earn the top pay rate very quickly. The disturbance of distributive justice made a difficult situation worse and virtually eliminated any chance that the union membership would vote to continue the autonomous experiment.

Discussions at the luncheon meeting in April 1989 suggested that a much more favorable labor-management climate exists today at Rushton than existed in the mid-1970s. The current union and management leadership deserves part of the credit, but the improvement also reflects a maturing of labor relations within the industry as a whole. The climate today appears much more favorable to the introduction of autonomous work than was the case earlier. It is a less radical innovation today than it was earlier. This favorable background would allow union and management some margin for error as they explored innovative work practices and tried to implement them. The Rushton experiment offers many lessons for those undertaking such an innovation today. Among these lessons are that active roles must be created for all stakeholders in future forms of work. The roles of participant, evaluator, observer and sanctioner of an experiment may be played by the same or different persons as the experiment evolves. No person need be confined to playing only one role if everyone in the organization is encouraged to experiment and learn continuously.

Postscript

The public utility that owns Rushton announced in January, 1991, that the mine would close the following June and that two of its other mines would close in 1992. The company said that Rushton's remaining two million tons were too expensive to mine. The men who came to lunch in 1989 had been hearing for 10 years that the mine might close if prod uctivity did not improve, but they had somehow hoped this might not happen. As reported earlier, productivity had increased four-fold over the previous 12 years, while pay rates had increased two-and-a-half times. Although any single-factor measure of productivity should be viewed cautiously, these numbers indicate that productivity per payroll dollar had improved significantly during these years. This improvement apparently was not sufficient for Rushton to remain economically viable to its owner.

It is tempting to speculate what might have occurred had the experiment in autonomous working survived and spread throughout the mine. The improvement in performance during the critical period might have been maintained and even amplified with the introduction of new technology into the mine. If so, Rushton's current economic outlook might have been different. Two hundred and fifty employees might have been able to work for another three to five years and the closing of Rushton, although inevitable, might have proceeded with more time to plan for the retraining and job placement of its employees.

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