

Technical report N° 14

Translation : French
Distribution : Enterprises

JOB CONTENT OF TECHNICAL STAFF WORKING
BELOW GROUND IN COAL MINES

Source : Ergonomic team of the German coal-mining industry
Project N° 1

Authors : W. FRICKE, E. FRICKE, G. PORTMANN, W. SCHMIDT, M. SCHÖNWÄLDER

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Financial assistance was provided for this study by the European Coal and Steel Community and the "Landesamt für Forschung" in the Ministry of Science and Research of the "Land Nordrhein-Westfalen"

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JOB CONTENT OF TECHNICAL STAFF WORKING BELOW GROUND IN COAL MINES

- Summary of results of study -

1. PURPOSE AND METHODS OF THE STUDY

The purpose of the study was to determine the job content of technical staff working below ground in coal mines. The form, content and cooperative relationship between the observed activities were viewed as a dependent variable of the production technology and operational organization; activity changes and changes in the functions of technical staff were explained by the process of technical and organizational adaptation in the mining industry. Particular attention was given to the relationship between the function, activity and qualifications of staff : do the technical staff have the appropriate qualifications for their present and future functions ? That was the initial question. One of the main results of the study was a correction to this particular question : the problem is not so much to determine whether technical staff have adequate or appropriate qualifications as to create and maintain organizational conditions in the undertaking which will permit staff to apply and develop their existing qualifications.

The study was directed at technical staff in the five-stage hierarchy adopted in the mines, ranging from the pit manager (head of underground operations) to the shift foreman. In order to ascertain the content and structure of their activities, the research team observed a total of 47 technical staff members in 207 shifts between October 1970 and February 1971, following their activities from the time they entered to the time they left the pit area. These were accompanying observations based on a

pre-structured programme by means of which the purpose, place and duration as well as the form of cooperation, extent in time, material scope and freedom of action of the individual activity were determined. The accompanying observations resulted in 4000 typewritten pages of observation reports, which were partly evaluated as case studies and partly used quantitatively to determine the focus of activity and cooperation patterns. In addition the observation results and the problem awareness of the research team acquired during the empirical studies were used in formulating the questionnaire for the written survey addressed to technical staff which formed the second part of the study in the autumn of 1971.

For the accompanying observations, three pits were selected, in cooperation with a project committee of Ruhrkohle AG, as a function of characteristics of the technical and organizational structure, in such a way that their technical facilities and organization differed as widely as possible. In this way it proved possible to study different aspects of the two main variables, technology and organization in the pits, and so to combine the methodological advantages of a time-series study with the economic advantages of a time-point survey.

The written enquiry took place in the same pits as had been chosen for the accompanying observations. As in the period between observation and questioning a decision was published by the central administration to close one of the three pits, and in order to check a possible observer influence on the results of

the questioning, a fourth pit was chosen for the interviews. 545 technical employees took part in the survey which was planned to give complete coverage; this corresponded to an average of 65.5 % of the underground supervisory staff in the four pits.

The technical staff generally showed real interest and sometimes even a commitment to the observations and interviews. We are grateful to them for this form of cooperation in the study. We must also express our appreciation to the pit managements which left us a free hand in selecting the staff members and shifts to be observed.

2. THEORETICAL BASIS OF THE STUDY

The state of production technology and its development trends as well as the practical organization of the working processes were analyzed as the principal factors which determine the present functions and activities of technical staff working below ground and are also changing in the course of the process of "technical and organizational" adaptation. Special attention was given to the interdependent relationship between the two variables and the fact that they jointly determine the structure, content and cooperative relationship of the underground activities of technical staff.

German industrial sociologists have been studying the interrelationship between technology and organization since the publication in 1959 of the paper entitled "Technology and industrial work" by Popitz and Bahrtdt; in this study, the authors deduce the appearance of new forms of cooperation,

i.e. an element of work organization, from the use of changed production techniques. The influence, through the intermediary of operational organization, of technical changes on the activity content and job situation of industrial workers was the subject of a study by Kern and Schumann of "Industrial work and worker awareness" (Göttingen, 1970). However, in this study changes in industrial work are still related comparatively directly to technical change, although theoretically the authors realize that the correlation cannot be a direct one. Only in a later work by the Sociological Research Institute (Mickler et. al. "The Relationship between technical change and social attitudes", Göttingen, 1971) are the possibilities of alternative work organization solutions examined specifically within the framework of technically structured production processes. Finally in his notes on a "Theory of technical progress", Lutz already drew attention in 1967 to the fact that the association of practical activities with technical processes involves considerable variation possibilities and latitude which may be utilized by the instances responsible for work organization. The existence of this latitude is reflected in the fact that the work function required by a production process with a specific technical content can be performed by a series of different specific activities; in addition variations are also possible in regard to the quantitative and qualitative nature of the labour force assigned to the process.

The working functions of the technical staff can be

derived from the dominant features of the underground production process : it is shown how, through the partial introduction of continuous production with a varying level of mechanization of individual processes (extraction, transport, lining etc.), simultaneous concentration of coal extraction on a few highly mechanized large faces and the resulting increased rate of coal winning, a number of specific problems - involving planning, organization, coordination and integration of partial processes - arise, which must be solved by cooperation between the technical staff concerned (chapter 1.2, p. 22-60).

However, the knowledge of the totality of tasks required by the production process does not enable any conclusions to be drawn on the activities to be carried out or actually carried out by individual staff members. Through work organizational measures (distribution of functions between individual departments from the angle of time and content as part of the operational division of labour or between the various positions of technical staff) the total number of tasks to be performed must first be broken down into a large number of individual activities and then assigned to the persons occupying specific posts. In this way, the operational organization of labour which determines the division of labour and attributions, decisions and cooperation acquires a decisive influence on the activities of staff which has been detailed in the analysis of operational decision making, processes and forms of cooperation between technical staff (Chapters 2.2 and 2.3).

Summarizing the results of our considerations and the

relationship between technology and organization as joint parameters determining the activity of technical staff, it may be said that, viewed over long periods of time, the development of new technical production processes is the basic dynamic factor leading to changes in function, activity content and cooperative relations between individual technical staff and workers. The history of the transformation of productive processes in coal mining from systems of individual coal winning through partly mechanized processes to the present system of continuous winning shows, however, that the particular technical nature of the winning method determines the activity of technical staff only through work organization and the organizational structure of the coal mine in the broadest sense. In the course of time, the technical members of staff first assumed supervisory functions for largely autonomous groups of miners; in the phase of partly mechanized cycle production they then exercised direct powers of instruction and control in respect of other personnel in order to ensure the maintenance of specific output norms and thus reduced their earlier distance from the work processes. Today technical staff are primarily the leaders and coordinators of highly differentiated production processes whose activity is becoming increasingly integrated into the actual processes. To influence the working results and fulfill performance norms, they must, however, in the first place, maintain the efficiency and continuous operation of the production processes; direct

instructions to other personnel to increase the intensity of work are ineffective to the extent that the rate of work and results achieved are increasingly determined by mechanized production facilities.

As a result of this development, the function, activity content and work situation of technical staff have all changed : the main centre of their activity has moved from the supervision of individuals and working groups to the management and coordination of technical production processes. The rate of production and production result are largely determined by the production system. To the extent that the distance between their activity and the production process is reduced, the freedom of action of technical staff at the middle level is also limited and their opportunity to organize their work in terms of time, space and content have become smaller.

Only one element of their activity has outlived all technical changes : the hierarchical organization of middle management and its cooperation. While the hierarchy was perfectly functional as a controlling order, it leads to operational friction to the extent that it is updated as a form of cooperation in the management of production processes without at least modifying the traditional rules of hierarchical cooperation.

The history of technical and organizational change in the coal mines and the analysis of its interdependent relationship show that the alteration in operational organ-

ization is proceeding much more slowly than the development of production technology and work organization in the narrowest sense of the term. This state of affairs has far-reaching effects on the activity of technical staff because it means that the requirements placed on them are to some extent contradictory. This is a characteristic of the activities of technical staff : the activities of workers which are more directly connected with the production process result to a much smaller degree in contradictory demand. For this reason, the organization of the process-related activities of workers changes more directly as a function of technical activities than was the case with the activities of technical staff. There are clear differences, related to the logic of the process sequence in each case, between the independent working groups performing all coal-winning, transport and lining activities in the phase of manual production, the working groups cooperating in teams but functioning in separate cycles in the coal-winning, transport and lining shifts in the partially mechanized second phase and the working groups cooperating on the basis of a special structure in the phase of continuous process production.

On the other hand, the activity of technical staff members is less directly involved in the production processes. Their function is determined to a substantial degree by the rules of operational organization. The dual nature of the requirements placed on the activity of technical staff results from the fact that they are on the one hand members of a

hierarchically structured order with instruction and controlling functions while on the other hand having to cooperate on the basis of rules other than those of a hierarchical nature as the leaders and organizers of technical production processes. As the operational organization with its hierarchical structure, distribution of powers, arrangements governing cooperation, information and decisions contains elements which have a considerable retarding effect by comparison with the work organizational approach to production processes and since these elements - as is shown by the presentation of historical trends and the systematic analysis of the relationship between technology and organization - are opposed to the adaptation to technically determined work sequences, the activities of technical staff vary less directly as a function of technical developments. To put it differently, in contrast with the activities of workers, the activities of technical staff are subject, because of the comparatively low adaptability of organizational structures to technical change, to a greater extent to requirements belonging to already updated development stages of mining production.

Nevertheless, the technical staff have to handle the requirements of the current production system, i.e. at present those presented by continuous production. A series of research results shows that some of the retarding features of operational organization structures hinder staff in exercising the functions necessary to lead and coordinate continuous and highly differ-

entiated production processes. This is true for some forms of hierarchical cooperation which frequently hinder the horizontal cooperation necessary for the coordination of processes involving division of labour, particularly when they involve interaction beyond the limits of separate departments (Chapter 2.3, page 87 ff, page 108 ff). This is also true of the frequent practice of centralized data processing and decision-making which takes insufficient account of decentralization of operational decisions necessary for specialized and differentiated production processes (Chapter 2.3, page 63 ff). Finally, it also applies to the definition of working success, explained largely by mining tradition, in terms of a daily output figure which fails to take account of the fact that technical staff must successfully manage their pits on a long-term basis having regard to changing geological conditions and bearing in mind mining, technical, economic and safety factors. In addition, there is a constant acute shortage of labour and adequately qualified staff and many bottlenecks in materials supply which compel many staff, in some cases even involving mine foremen, to cooperate in specific processes. In conjunction with these routine activities which have to be performed daily, it is this need to cooperate which prevents many staff from participating in the forward planning of production processes and in the use and further development of their qualifications during their daily activities. Overloaded by routine activities which make an inadequate call on their capacities as far as the use of their skills is concerned - such is the work situation of many technical staff employed in mines.

In the phase of continuous production, all members of the middle technical management ranging from the shift foremen to the pit manager, have become leaders and organizers of the underground mining processes. Therefore the activities of mine and operational managements do not differ in principle but primarily in terms of their scope in time and content in the production sequence. Just as the pit foreman acts as the manager and coordinator of partial processes in his pit, the operational managers in charge of underground working have coordinating and managerial functions to perform which relate to a larger number of partial processes and are frequently also characterized by their longer time coverage. The traditional division of labour which still dominates, reserving in principle planning activities and operational decisions for the operational management while the mine foremen are simply in charge of the current organization of the coal-winning process and direct supervision of workers' activities, is no longer appropriate to the current status of technical development : high coal-winning speeds in highly mechanized large pits and the interdependent nature of a large number of partial processes which now have to be coordinated by pit managing foremen, increasingly require planning activities and in some cases far-reaching decisions by staff directly in charge of the production processes at the pit face.

The adaptation of the activity structures of

technical staff in different hierarchical positions expressed in the increasingly close contact of activities of mine managers and senior foremen with the process itself, has led to a clear reduction in the social distance within the five stage hierarchy of the middle technical management. As a result important features of the work situation below ground have increasingly come to apply to all technical staff from the shift foremen to the operational manager. The traditional structural features of the operational organization often hinder the mine manager in the exercise of his functions of leader and coordinator of production processes no less than the pit foreman : both require the centralized decision-making structures, horizontal forms of operational cooperation and relief from routine activities. Basically, both are in the same situation in regard to the possibility of using existing qualifications in the working process and in regard to the opportunity of translating newly acquired qualifications into effective action against the resistance of structural factors. This is particularly true for the deficit of managerial knowledge and organizational and planning qualifications ascertained in the study : without a simultaneous change in operational rules of decision-making, cooperation and division of powers, operational managers and shift foremen will be confronted with difficulties if they try to apply new organizational and managerial knowledge.

3. SUMMARY OF MAIN RESULTS

Of the 545 technical staff members studied in the four pits, only 38 % were younger than 40 while 14 % were 50 or more years of age. Only 3 % were below the age of 30 and these were without exception shift foremen (see Chapter 3).

2/3 of the persons studied had already been working in pits for more than 20 years and 10 % for 30 years or longer; only 1 % of the staff had been in the mining industry for less than 10 years. These figures reflect the method of recruiting technical staff in the mines : the present technical personnel have spent a considerable part of their employment in the mines as ordinary mine workers; the main criteria for their selection therefore appear to be professional experience and practical knowledge of mining work.

It is of course only reasonable to make such requirements if there is no basic difference between the activities of workers and technical staff. In practice, the recruitment of technical staff in the past was based on that assumption; as a result all pit managers responsible for underground working had to pass through the entire five stage hierarchy of under-ground management from the position of miner upwards. Practical experience therefore far overrides knowledge of technical, economic and social conditions of the pits in their training. Only recently with the training of technical staff at mining schools has the previous method of training and recruitment given way to a greater emphasis on theoretical knowledge; during our study we already met the first graduates of this new form of training in the pits. Although miners of the old school criticized them for their lack of practical knowledge, they gave the impression, without exception, to the research team that they could discharge

their duties at least as well as staff with years of professional experience holding similar positions (Chapter 3.2).

The data on the age structure and length of service in the mines also gives an idea of the time required to reach the position of technical staff member : if only 1 % of technical staff have been active for less than 10 years in the mines, promotion from the position of miner has generally taken at least 10 years; in the past miners became supervisors at the earliest at the age of 30. The establishment of mining schools with new entry requirements seems to be putting an end to this practice too; in the past the qualifications considered necessary were imparted over an extraordinarily long period of time as the importance attributed to professional experience far exceeded the actual demands made on managers under ground.

The distribution of the age groups between departments working under ground is not uniform. In three of the four pits at which the enquiry took place, the elder staff members above the age of 50 are mostly found in the pit gas, blasting, dust control and safety departments : between 40 and 50 % of the staff of these departments are 50 or more years of age while in the coal-winning sections only 5 % of the persons surveyed fall within this age group in all four pits.

Of the 545 persons studied 58 % were shift foremen, 22 % area foremen, 13 % general foremen, 4 % pit foremen and 3 % undertaking managers. Nearly 2/3 of the staff questioned had undergone the normal course of training through preparatory mining school, mining school and senior classes (15 %); some 15 % had undergone in-service training at a supervisor's course and the remainder had reached their present position through

other training channels (table 34, chapter 3). It is striking that on average only 40 % of those interviewed considered their training to give adequate preparation for their present activities while 60 % are dissatisfied with their training from this aspect (Table 45). The dissatisfaction with training is particularly high in the coal-winning departments where 65 % express dissatisfaction; the figure corresponds exactly to the average in the electrical departments and is lower than average with a figure of 50 % in the machine departments. Satisfaction with the training given rises as the posts held become higher : 35 % of the shift and area foremen consider their training to have been good, 40 % of the general and pit foremen hold the same opinion of the training received (Table 46). It will however be noted that these judgments tend, to some extent, to reflect satisfaction with the position reached and activity performed so that they do not in fact represent a straightforward judgment on the qualifications actually acquired and their appropriateness to the job responsibilities. About half the technical staff from the shift foremen to senior foremen believe that their present activities correspond to their knowledge and abilities while the other half believe that they are under-employed. Only the general foremen, who have no mine school training, and the pit managers feel, in some 3/4 of all cases, that their activities make adequate use of their potential.

What is the true background to this comparatively widespread dissatisfaction of technical staff with their training and activities performed by them ? An outline of the main results of our accompanying observations will help to answer this

question; we shall compare the observed working conditions from case to case with the corresponding verdict of the staff concerned.

The average working time of the staff (defined as the shift time or time present in the pit) is 10.5 hours per day and the variations from pit to pit amount to a maximum of 1 hour. This value is on the low rather than on the high side : often the staff must do work at home; only 35 % of the persons interviewed stated that they did not do additional work at home, while 11 % referred to an additional working time in excess of 6 hours per week (chapter 2.1, page 25).

The daily working time of technical staff ranging from shift foremen to general foremen centres on underground work (between 60 and 85 % of the shift was spent underground) while in the case of undertaking managers, the emphasis is clearly on work performed above ground only about 30 % of their working time being spent in the pit; in the case of mine foremen, the time spent above and below ground was the same. The values for the shift time spent underground appear to us very high for all positions; we interpret them as a first indication of the high degree of process-related activities on the part of all technical staff which is one of the characteristic features of technical staff work in the mines.

Taking the average of all observations, only about 2/3 of the observed shift time was taken up with productive activities directly related to the production process. The remaining

third of the working time had to be used for travelling and approach requirements (up to 60 %) and a further 10 % (maximum) for breaks in work. The high travelling and approach times generally present a heavy loading on technical staff in addition to their actual workload; up to 24 % of the staff indicate long journeys on foot as a source of additional strain. Except on main roads, technical aids to transport personnel (man-riding) are still a rare exception.

3.1. Principal activities of technical staff in area management
(chapter 2.1, pages 37-97)

The middle technical management in all three pits at which observations were made showed polarization between area management (shift and area foremen) on the one hand and pit foremen and managers as members of the operational management on the other. The activities of both groups are characterized by identical structures but differ clearly in terms of their scope as a function of time and content in the production process and in the degree to which they are related with the process : the area and pit management centres on informative, controlling and organizational activities covering a good 2/3 of their entire activities; in the case of area management, the emphasis within the three functions lies on organizational activities while the pit management in the various pits does not show a uniform pattern because organizational features of the pits concerned lead to a different distribution of job responsibilities between the technical staff and therefore to different activity centres (see chapter 2.1, table VIII).

The members of area and pit management groups work as a team. The division of activities is sometimes such that members of the team alternately exercise similar activities (e.g. area and shift foremen working in different shifts). In general, however, the division of labour is such that the lower ranking of members of the team are engaged in the more directly process-related activities - reflected in the fact that the pit foremen spend a greater part of their working time below ground than the pit managers and in extreme cases, may even take part in the processes underground.

In terms of their position and activities, the general foremen cannot be clearly attributed to either group. In the different pits we found different solutions ranging from the use of general foremen as senior area foremen to the exercise of routine activities to relieve the load on the operational management. In each case, the general foremen assumed an intermediate position involving many conflicts between the area and operational management; there was a tendency to use them to reinforce the area management in large areas.

In the case of shift and area foremen, active cooperation in the production process is a further centre of activity in addition to their informative, organizational and controlling functions; in the case of shift foremen, this activity proportion is 14.4 % on average, 10 % for area foremen and 6.9 % of shift time for general foremen. The need for active participation in the coal-winning process which is not compatible

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in real terms or according to the demands of the pit management, with the supervisory function of technical staff was primarily a result of the personnel shortage which we repeatedly observed and was constantly complained of by the staff themselves. The lack of personnel is reflected in two phenomena : on the one hand, the theoretical staffing of pit areas is often calculated so tightly that the actual staffing often falls below the minimum labour requirement for a shift. On the other hand, the staff required for key working positions is in the shortest supply (cutting machine operators, machine drivers, hewers). If one of the key workplaces in a shift is not filled, the area foreman is obliged to perform the appropriate work at least for the current shift unless he can find an appropriately qualified replacement among the remaining staff. The result of this practice is that the area foremen lose the necessary distance from the processes which they are supposed to coordinate and manage; they often then do not have a general view of what is going on and are taken unawares by problem situations without having time to find an appropriate solution. The foremen know that - quite apart from the additional workload - they are being wrongly used to take part in the production process. They express their views clearly as in the case of the area foreman whose comments are reported in interview record No. 319 : 'It is not the real purpose of my job to spend the entire shift at a workplace which should be occupied by someone else'. However, the area supervisors see no possibility of gaining acceptance for their ideas as to the staffing of their areas on the part of the pit management staff and undertaking management (see chapter 2.1, pages 42-45 and page 75 ff).

3.11 Nature of main activities of technical staff in area management

The function of technical staff in the production process has changed from the supervision, control and direction of working groups to the management and coordination of mechanized production processes. This functional change is clearly reflected in the fact that the main object of the activity of all technical staff is to ensure the effective operation of the technical equipment and materials supply systems, taking up 20 to 25 % of their working time; second and third places in the activities of technical staff up to the level of general foreman are taken by concern for good qualitative and quantitative results (meeting the performance norm) and work organizational activities (allocation of job functions to staff, making new arrangements where personnel is lacking or in the event of interruptions and disturbances in operation). In the case of the operational management whose activity is less directly related to the production processes, the activity pattern is rather more diffuse and here again, deviation specific to the individual pits can be observed as a result of the different organizational solutions adopted (see chapter 2.1, pages 46-49).

A constantly recurring feature of the activity of technical staff is their high level of job motivation. Where the regular sequence of operation and compliance with performance targets appeared to be endangered by organizational deficiencies in material supply and job organization, shortage of labour and materials or technical faults, the technical staff generally try to compensate for these bottlenecks and organizational deficiencies by increased work intensity. The high motivation of the

technical staff extends to the point of identification with the pit and its output : the mine director and the worker at the pit face alike tend to speak of 'my coal'.

This attitude to their work enables staff to bear a high level of pressure; it also leads to personal initiative which is not always accepted by the pit management. An example of this is the ideas put forward by shift or area foremen to adapt the technical equipment of their specific sectors or parts of the coal-winning process to changing geological conditions. Because of the high pressure in the working sequence and the demand of routine tasks they regularly use their leisure time to solve such problems of adaptation but if their ideas lead to proposals to change processes or re-equip areas, they have to bring additional energy to bear in gaining acceptance for their initiative in the mine decision-making process and under certain circumstances forcing their ideas through. We observed, however, that in the pit with the broadest level of participation in the decision-making process in which the area management had at least an advisory function, innovative and problem solving initiatives taken by technical staff at all levels were comparatively frequent and partly also successful. On the other hand, in the remaining pits where planning and decisions on process alterations and technical improvements were reserved strictly for the pit management and its experts, such initiatives were not taken or else met with resistance or disinterest on the part of the higher management.

The high job motivation of technical staff with its positive and negative sides corresponds to a management style which is present with varying degrees of emphasis in all pits and may be described as personalization of problems. It is reflected in the fact that individual staff members may be made personally responsible for the performance of their pits or that where interruptions of output and technical faults occur, the higher management tends to look for the 'guilty person' rather than for the causes of the faults. It hardly needs mentioning that these methods of mobilizing job motivation are today less than ever appropriate to the technical level of production processes below ground and the operational problems encountered.

3.111 Technical equipment and materials supply as the focus of activity of area management

It is a reflection of the advanced level of mechanization of underground work that up to 25 % of the activities of the area management is accounted for by technical equipment and materials supply (see chapter 2.1, page 46 ff); this is true at least in so far as the technical staff have a controlling and organizational say in technical equipment. The incorporation of supervisory personnel in the production process in the form of cooperation which may account for up to 14 % of the overall activity of shift foremen cannot, however, be explained any longer by reference to the requirements of mechanized production processes. This is in fact a problem of the shortage and sometimes complete inadequacy of the

quantitative and qualitative staffing of the production processes which forces area management staff to intervene in the actual processes.

This tendency which leads to a partial reduction in the level of functions of technical staff results from the fact that work organization and the qualitative composition of the mine personnel do not yet correspond to the current level of technical development. In the course of the increasing mechanization of underground work, activities requiring low qualification have largely been transferred to technical equipment while more demanding activities (control work of the machine drivers, maintenance work, fault prevention and repair) have remained unchanged or increased in importance. The staffing and training policy has reacted to this development by preparing special qualifications for key workplaces. However, it has not proved possible to raise the overall level of qualification of mine staff accordingly. The result is an extraordinary shortage of specialists who may be used at key workplaces and the allocation of personnel, especially to the coal-winning areas who are sufficient to perform normal working activities but quite inadequate to overcome faults and major interruptions of operations if they arise. Area management staff are therefore obliged to perform the activities of workers themselves when faults occur or to replace persons filling key workplaces when they are absent. In this way, they often lose the distance and insight which are urgently necessary to solve problem situations. Defective behaviour in problem situations cannot therefore be adequately explained by a lack of qualification of technical staff as is frequently the case in the

pits observed; insofar as these qualification deficiencies in fact exist and should be remedied by appropriate training measures, the organizational requirements for the use of these qualifications must be created at least as an accompanying factor.

From our observations and discussions in the mines studied, we gained the impression that the tendency to involve the area management in the production processes and the resulting lowering of the status of shift foremen is not being corrected even if it has now led to an emergency situation at area management level which cannot be allowed to continue in the long run. In our opinion, the solution to the problem which will be found in the long term by the pits must lie in a quantitative and qualitative strengthening of the area management. Analysis of the activity centres of general foremen and their cooperation with staff in other positions shows that general foremen are increasingly being used to reinforce the area management in all the pits studied (see chapter 2.33, page 74 ff). In this way, organizational solutions are being developed which correspond to the requirements placed by highly mechanized large areas on area management and may at the same time compensate the decline in managerial activities by including shift foremen in the actual work process.

We have seen that in the present state of technical development technical staff act as organizers and coordinators of technical processes, control the conditions of technical

equipment and - as an expression of an increasing process integration - are frequently obliged to give their support to the mine workers. To handle these functions in the area of 'technical equipment and materials supply', the area management staff required the following qualifications :

- Knowledge of all process - integrated activities in highly mechanized partial processes and the ability to carry out these activities themselves in order to compensate for work organizational deficiencies and the quantitative and qualitative labour shortage (consequence : reduction in the level of duties performed by shift foremen).
- Good technical knowledge in order to carry out preventive controls on all technical equipment in the pit area and take measures to remedy faults.
- Process-specific mining, technical and organizational knowledge and ability to organize and coordinate partial processes.
- Ability - not specific to the process - to analyze fault situations and formulate strategies and problem solutions.

With the present division of labour between operational and area management, planning ability in regard to technical equipment is not required of the area management or if so to a limited extent (see chapter 2.1, pages 48 and 66). To the extent that planning functions have to be performed, they consist of detailed technical planning with

a limited scope in time and generally aim at adaptation corrections to area equipment in whose planning the area management played no part. Such is the present position; whether this organization of management activities and the division of functions between the pit and area managements is rational, is another question altogether.

To sum up, on the basis of the research results outlined up to now, the work situation of the area management may be characterized as follows : as a result of the change in the nature of the duties of supervisory staff who have become organizers and coordinators of mechanized production processes, the activities of area management are increasingly coming to centre on technical equipment. The possibilities for the lower levels of middle technical management (including general foremen) to influence planning or change technical equipment are, however, small. The activities of the area management are becoming increasingly close to the actual process, and are thus determined to an even greater extent by technical equipment; the extreme example is that of work performed by technical staff in the actual process. Work organizational shortcomings at individual pits and the general staff shortage heighten this tendency - which results in a decline in the qualifications of shift foremen - but do not explain it.

The technical staff understand their situation and have an altogether realistic view of it : only 10 to 20 % of the area managers in all pits believe that they are in a position to influence the technical equipment at their

point of activity and remedy difficulties. Where working materials are defective or lacking, only every second member of the area management believes that his capacity is sufficient to remedy the shortcoming (see chapter 2.1, pages 58, 67 and 71).

3.112 Activities of work organization

Work organizational activities of area managers (and also of general foremen) come in second place in order of importance occupying 12 to 25 % of the shift time. The extent of these activities and the load which they place on staff is unaffected by the level of technical development; it is on the contrary influenced by general organizational arrangements in the individual pits and above all by the staff shortage and the level of the daily output norm (see chapter 2.1, page 72 ff). We observed in many cases that in situations where the requirements of normal, undisturbed working were met, the area management was relieved of all responsibility for allocating staff and distributing current work. The senior miners and personnel were able to handle these functions for themselves if

- the staff consisted of a well-trained team;
- the senior miners had good organizational qualifications approaching those of the area management;
- no members of the shift were absent;
- the daily norm was known and corresponded to a reasonable level.

Under these conditions, the various working groups in

an area in conjunction with the senior miner were able to organize for themselves and take responsibility for shifting, hewing and transport equipment, conveying material, informing the blasting supervisor, carrying out lining work and performing other routine activities. As a result, the technical staff were relieved of many of their routine functions; they did not have to give constant detailed instructions and were able to concentrate instead on the coordination and organization of the various partial processes in the area.

This normal state of affairs which enabled the area management to discharge its function as leader of the production processes without substantial additional tasks, was an exception in all the pits studied (see chapter 2.1, page 76 ff). We repeatedly observed that the area management had to perform the following activities :

- Make sure that staff arriving corresponded to the scheduled numbers; where staff members were absent, attempt to ensure that important workplaces were occupied by other members of the same shift or by borrowing personnel from other areas; in many cases, the foreman himself has to perform the work of the absent person.
- Organization of allocation of staff jointly with the senior miner.
- Decision on the sequence and urgency of the work to be done and corresponding organization of the use of labour in each individual case.
- Control during and after the performance of work, further

organization of the use of labour.

- Where replacement staff are present or jobs requiring few qualifications have to be performed, instructions are given by the foreman when experienced miners are not available to accept this responsibility.

The activities outlined above are not affected by the state of technical development in underground working; on the contrary they are determined by work organizational arrangements in the individual pits, the quality of staff planning (often the nominal staffing is so tight that the absence of 15 to 20 % of the staff makes work impossible), the qualification of personnel and the need to achieve output targets set daily. In our opinion, the area management could be relieved in large measure of the need to intervene directly in the work process only by ensuring the possibility of establishing the necessary equilibrium of repair and maintenance work, lining and safety activities and transport capacity at longer intervals instead of within 24 hours, in conjunction with a more flexible labour organization. If it also proved possible to acquaint all qualified labour in a team on the basis of a rotation system with the activities of all key places in a particular area, the problem of finding short-term replacements for these workplaces would be solved more easily. At the same time, this job rotation method would increase the autonomy of the working groups which could then relieve the area management of a series of detailed problems concerning the use of labour and allocation of staff. Finally, an organizational solution of this kind would in the long run increase the qualification potential of

the area personnel and after being relieved of routine tasks, the area management would be able to use its qualifications to manage and coordinate production processes and develop its abilities further.

3.113 Quantity and quality of working results as an area management function

Technical area management staff are not only responsible for meeting quantitative output standards (daily norms), but also for the quality of the results of the work performed by their staff reflected, e.g. in correct lining operations, the situation of the coal winning operations in general or the coordination at the correct time of the gallery advance and progress in coal winning. Although quality and the required output are in the long-term independent (sooner or later the neglect of qualitative factors in daily coal-winning operations will lead to a situation where the daily norm can no longer be met because of the poor state of the long-wall), short-term conflicts may easily arise between the maintenance of quality standards and the requirement for the daily norm to be met (see chapter 2.1, page 86 ff). Technical area management staff use 15 to 20 % of their working time in achieving qualitatively and quantitatively satisfactory working results with their personnel (their attention clearly centres on the need for quality in the working results). As the area management bears technical and legal responsibility for the sufficient quality of the working results, on which in the long run, not only the output of an area but frequently also the safety of underground work depend, it is not surprising that

the area management checks the quality of working results by constant control (chapter 2.1, pages 46, 87/88 and 94 f).

Quantity and quality of the working results are not only dependent on the technical equipment of the coal-winning operations and on the use of staff. Non-technical factors such as materials supply, the level and uniformity of the daily norm, working organization (rated and actual staffing, cooperation and independence of working groups) and the level of qualification of workers and technical staff all play a part. Depending on the extent to which these factors are favourable, the technical staff also have to determine their own efforts to achieve quantitatively and qualitatively satisfactory working results through organizational steps or even personal intervention (see chapter 2.1, table 18, page 94 f).

Finally a decisive factor is the way in which the priority of quantity or quality of work is decided at the individual pit and the extent to which this conflict exists at all. In our observations, we found that there is a clear correlation between the intensity of this conflict and the forms of cooperation and decision-making prevailing in a pit. In a pit where, through participation in management, there is at least basic involvement of the area management in operational decisions, we found a noticeably calmer operating situation at the coal face which was less sharply characterized by pressure for performance and constant compromises between the need to meet the output norm and quality standards. Our observations suggest that this success is less attributable

to a management style differing from that adopted in the other pits than to the fact that in the organization of the managerial activities at pit and area level better account was taken of the requirements for continuous process production in large areas than at the other pits.

The work organizational innovations which, in our opinion, point to the way in which future developments will move, consisted in particular of a systematic strengthening of the area management through the rational use of general foremen. While in the other pits, the general foremen (and sometimes also mine foremen) were used to strengthen the area management as an emergency measure taken under exceptional circumstances, the systematic nature of the innovative organizational arrangements is reflected in the fact that general foremen, in the context of their activities in the management of large areas, are also made responsible for some of the routine operational management functions (in particular information activities). In this way the function of the area management is extended while the pit management is relieved of some of its routine activity and is better placed to perform its primary managerial role. Strengthening the area management, relieving the load on the pit management and an altogether smoother operating cycle were the positive results of the reorganization outlined (see chapter 2.3, page 69 ff).

3.12 Principal activities of technical staff in pit management

The activity of technical staff in pit management functions (mine foreman and pit manager) is more disparate and

less concentrated on centres of emphasis than in the case of area management staff; this applies both to the different types of activity and to the natures of the activity involved (see chapter 2.1, page 98 ff).

The proximity to the actual process is comparatively important in the case of pit management staff (see chapter 2.1, page 32). The mine foreman and pit manager intervene with varying frequency in the tasks of the area management (see pages 105/106), but they often give detailed working instructions which require an accurate knowledge of the processes in the pit; their intervention and detailed instructions refer primarily to the allocation of staff and the elimination of faults (page 102 ff). It is striking that in cases where the activities of the pit management are close to the actual working process, deficiencies in the system of organization determine the activities of all technical staff from the lowest to the highest level and these staff then have to solve constantly, as in the case of the area management, problems of materials supply, allocation of labour and quality control.

Our studies showed that even pit managers responsible for coal winning departments are engaged for up to 2/3 of their working time on activities directly dependent on the developments and specific occurrences in a particular shift. Consequently, only 1/3 of their time is available for managerial activities which extend in time and content beyond the narrow horizon of the current shift (see chapter 2.1, pages 155/156). The comments applicable to area managers are also applicable although to a rather lesser degree, to pit

foremen and managers : the freedom of action for technical staff in regard to the sequence in time, content and place of their activities is extremely limited. Only when the operations are proceeding unusually smoothly is this non-typical situation for staff activities temporarily improved, although the possible freedom of action which seems essential to the long-term orientation of management activities is constantly and systematically limited to an undue extent by the practice of setting daily norms.

In our view, the limited freedom of action and increasing integration of the activities of pit foremen into the actual cycle of working in the pit have a direct influence on the activity of the mine management which may be characterized as follows :

- Increasing process-orientation and process-dependence of mine management activities.
- Extensive exclusion of the mine management from planning and forward guidance of production processes.
- Displacement of planning and sometimes even of process management to the work management level; actual planning tasks exceeding a particular scope and complexity are even effected outside the individual pit involved.
- There is a resulting reduction in the planning and innovation potential of technical staff at all levels. To the extent that this trend is not founded in the general loss of function of technical staff, it can only be stemmed by a re-organization of decision-making and cooperation processes.

The management style and problem-solving potential of the pit management, in particular in the case of almost all the managers observed by us, are characterized by the personalization of problems and conflicts. Even the failure to meet the daily output norm, insufficient quality of the working results or interruptions in operation due to technical or organizational faults are viewed as personal errors on the part of area management staff. In addition to the daily division of work, this was the main function of the early morning discussions between the pit and area management staff which we observed in two pits and were more in the nature of a morning role-call than of work discussions (see chapter 2.1, page 103 f, chapter 2.3, page 63 ff).

Technical staff are aware that operational problems are frequently personalized : 34 % of the staff questioned reported that their superior's first reaction to problem situations was to look for someone to blame (see chapter 2.2, page 91). An attitude of this kind is scarcely suited to tracing and remedying structural causes of friction; it tends rather to appeal to the already marked job motivation and performance readiness of technical staff and their identification with their work, this source of operational activity will probably be lost in time - quite apart from the fact that personalized management frequently leads to personal dependence and resentments, thus making the working climate more difficult.

The management conduct which we have outlined and is widespread among technical staff at all levels reveals a significant lack of management and organizational qualifications. Investment designed to provide an appropriate problem solving attitude and organizational and management knowledge therefore seems necessary; the effectiveness of such training measures will, however, depend on the success of accompanying and supporting organizational aids in the pits.

3.13 Summary

The results outlined so far may be summarized as follows : the requirements placed on the activity of technical staff cannot be deduced either directly or primarily from the degree of mechanization and technical equipment of the production processes. There are, on the contrary, a number of organizational and economic factors which determine the detailed nature of the job function and activities; these include in particular the way in which the cooperative performance of the management and coordinating functions required by the production process as a whole is determined by work organization and attribution of powers.

This relationship has its practical effect even if conclusions are drawn from the analysis of the activity structures and requirements on the provision of the necessary qualifications for technical staff. It must therefore be emphasized that it is not sufficient to give thought to the appropriate qualifications of the technical staff unless care is taken to ensure that work organizational arrangements and division of responsibilities within the plant encourage the

correct use of existing qualifications and above all their further development in the working process.

Correct utilization and productive organization of existing qualifications in coal mines involve, in particular, developing and strengthening collegial forms of pit and area management, raising and consolidating organizationally the independence of qualified working groups, relieving the technical staff of the need to perform routine activities in the procurement of materials, in allocating staff and organizing the use of labour, in processing and obtaining information and in participating in the production process. Decentralization of the operational decision-making process will also be necessary and staff must no longer be required to meet a fixed daily production norm without reference to the state of their working areas at any given time.

In the course of our studies, we identified the tendencies towards a more collegial organization of the management activities of area and pit management. In the pits where the basis for organizational innovation is apparent, it results in an activation of existing qualifications with a simultaneous removal of the need for staff to perform routine activities. In our view, these trends must be strengthened in the future. It must, however, be noted that in particular the decentralization of pit decision-making has not advanced very far as yet. Although as a result of the concentration on operating points, the increasing continuity of production and the rising capital intensity of coal-winning operations, some factors are also

working towards centralization of pit decisions, current decisions concerning the technical equipment of the operating points could certainly be more highly decentralized or taken with the cooperation of the area management. In addition, the development of institutionalized forms of cooperation between planning and executive groups is urgently necessary.

A general outline will be found below of some aspects of the organization of decision-making processes and cooperation between staff. It will be seen that collegial forms of decision-making and cooperation activate existing qualifications while traditional organizational arrangements tend to impede the use and further development of the available qualifications.

3.2. Organization of operational management activities - structure of processes of decision, information and cooperation in the pit

As outlined earlier, the method of accompanying observations was designed for the analysis of the activity of individual technical staff and the cooperative relationship between them. The analysis of operational decision-making processes would have required a method of observation directed towards problem relationships enabling decision-making processes to be followed from the stage of recognition of a problem situation through discussions and selection of alternatives to the formulation and implementation of a decision. On the other hand, an observation method which centres on individuals can only cover those sections of the operational decision-making process in which the observed person happens to play a part during the observation period by participating in decisions, giving advice or information and giving or receiving instructions. Previous decisions and the real scope and extent

of decision as well as the entire cooperative basis of a decision-making process cannot be systematically covered in this way.

The aspects of the operational decision-making processes which were accessible to us through accompanying observations and questions to staff are outlined below. Although, despite the methodological limitations, some insight into the structure of operational decision-making processes was obtained, it seems to us that these processes might well be made the subject of a separate study adopting a different approach.

In general, in the pits observed, the pit manager and area manager were at the centre of operational decisions; as in the case of the activity structures, the decisions clearly differed in terms of their extent in time and material content in the process (see chapter 2.2, page 28 ff). Considerable departures from this rule were observed to the extent that members of the work management sometime participated case by case, in a given pit, and sometimes also every day and systematically in the work of the operational management and even intervened in the current area management by giving direct, detailed instructions. In this way the operational decision-making centre was partially transferred to the pit management and in one case even to the works administration. It is interesting to note that in the most highly automated pit which also had the best ordered and most uniform operating sequence, the decision-making centre was situated at the lowest point in the hierarchy : the area management in this case had the highest level of authority to take decisions and relative independence; it also played at least an advisory

part in decisions on pit management (for a model of collegial pit management, see chapter 2.3, page 69 ff and page 90 ff).

The tendency to centralize operational decisions at the higher positions in the hierarchy which is explained by the traditional management and organization structure of the pits, is all the more remote from the requirements of production processes involving a division of labour as the increasing process speed, differentiation and interdependence of underground work require rapid decisions in the daily operating sequence; a decentralization of operational decisions would be necessary. The fact that the infringements of this requirement, although based on outmoded management attitudes, are not accidental but consolidated in many pits in the structure of the management system, is shown by the institution of a daily morning role call in two of the three observed pits.

For this morning role call, the area foreman had to report every morning to the pit manager or production inspector, the latter were acquainted from the report books or reports of the night shift foremen with the state of the coal winning and repair work during the previous days' shifts. On the basis of this detailed information, they either criticized or praised the area managers, gave detailed instructions for the next shift, requested cooperation with operational foremen and to some extent also themselves organized this cooperation while finally reporting control measures to be taken in the next shift : these measures frequently appeared as open threats

(chapter 2.3, page 63 ff).

This practice of centralized decision-making and intervention in the activity area management has the following serious consequences :

- Increasing lack of independence on the part of area managers whose organizational ability and management qualifications are wasted because they have no opportunity to use and develop them, innovative potential is unused.
- Cumbersome nature of the decision-making process which is frequently no longer equal to the need to take rapid decisions (see chapter 2.2, page 37 ff).
- Overloading the pit management with routine activities in an attempt to procure and process a wealth of detailed information and to intervene in the production process by giving detailed instructions.

The example of another pit shows that the consequences we have described of excessively centralized operational decision-making are not necessarily related with the management of underground operations. A changed organization of the management and controlling activities and in particular of cooperation between the pit and area management is likely to improve the present situation involving excessively centralized decisions, a cumbersome information system and the overloading of the operational management with routine activities; above all the qualifications of area managers would be better used.

The principle features or organizational arrangements departing from the traditional pattern are a different utilization of general foremen and closer cooperation between area

and pit management in taking operational decisions involving greater independence of area managers. Unlike the position in other pits, general foremen are used systematically - and not merely in an emergency situation - to strengthen the area management in large areas and they also assume the function of processing routine and detailed information which in other pits reaches the operational management without further processing. In this way both the area management with its reinforced staff and the operational management which is relieved of the need to perform routine work are enabled to perform their managerial and administrative functions on a more intensive and controlled basis; at the same time the entire operating sequence becomes smoother and more effective (see chapter 2.3, page 51 ff and page 69 ff).

By strengthening the area management, the internal balance of the pit hierarchy is also restored; it had been impaired by the centralization of decision-making and work functions at the pit management or even works administration level in the other pits. Only the transfer of problems requiring an independent solution to the occupants of lower positions in the hierarchy can compensate the excessive emphasis placed in any hierarchy on the higher level as opposed to the lower positions thus establishing a balance between all hierarchical stages which Bahrtdt defines as a requirement for the functional effectiveness of a hierarchical organization : 'The individual middle and lower hierarchical levels are responsible for increasing the range of power of the central administration : they have to represent the latter in a specific sector or at a specific point where the central administration is not present. They must therefore

not be mere objects or means but must also remain subjects giving practical effect to the necessarily abstract central will by adding their own resolve to it. But the factor which they personally add may also break the hierarchical system - that is one risk. The other risk is that this personal factor may be completely lacking. The top management will then either be forced to give effect to its own will itself, thus having to concern itself with every small detail. It will then be stifled by the excessive workload without managing to perform its actual task namely to take decisions. The intermediate hierarchical levels will then also become mere intermediaries in transmitting commands' 1)

The technical staff are aware of the characteristics which we observed of their working situation, especially the lack of authority to take decisions and the accompanying cumbersome nature of the information system. Every third technical staff member stated in the written questionnaire that he had insufficient freedom to take decisions and a further 13 % reported that they had adequate decision-making freedom only in emergency cases (see chapter 2.2, page 50 ff). Interestingly enough, this appraisal does not differ from

1) Hans Paul Bahrtdt 'Industrial bureaucracy', Stuttgart, 1958, page 56. According to Bahrtdt, the other requirement for effective operation of a hierarchical organization is obtained when the rule characterizing the hierarchical system, namely that only vertical connection lines are institutionalized, also corresponds to the functional processes resulting from the tasks of the organization. Our analysis shows that this requirement is frequently not met; this is particularly true for shortcomings in cooperation between staff in different underground operational departments, e.g. between coal-winning and functional foremen. See chapter 2.3, pages 60, 84 ff and page 108 ff).

position to position but rather from pit to pit : at pits with highly centralized information and decision-making structures, staff in all positions ranging from shift foremen to pit foremen, complain of lacking decision-making powers while the appraisal of all staff is certainly more positive when the organizational arrangements allow independence on the part of the area management and make for a collegial model of cooperation between pit and area managements.

Cooperation between pit foremen and managers within the operational management structure seems in general to present a problem in all pits and departments. It is striking that in all the pits some 2/3 of the pit foremen complain that they have inadequate freedom to take decisions. This result might suggest that pit foremen frequently only perform auxiliary functions within the pit management which do not meet their own demands for independent work (see chapter 2.2, pages 52/53). The area foremen who report increasing responsibility in their activities (increase in the size of the working areas), coupled with a loss of their freedom to take decisions, are in an even worse position (see chapter 2.2, page 95). Logically then, it is the area foremen who most frequently and urgently call for an extension of their decision-making authority and are also most willing to assume the resulting increased responsibilities (see chapter 2.2, page 99 ff). The willingness to assume greater responsibility is not, however, merely founded in the wish to acquire the authority needed to perform the set tasks but is also closely connected with the desire for promotion (see

chapter 2.2, page 105 ff).

Technical staff are not only aware of their difficult position and the restrictions on their work situation in the light of the centralized hierarchical decision-making structure in the pit, but also able to name reasons for these aspects of their working situation. A majority of the persons questioned explained their inadequate decision-making powers by organizational factors (central planning and deficiencies in the operational information system), while a second group emphasize the increasing dependence of the work processes and working rate on technical equipment; finally, a further quarter of the persons interviewed quote errors in the management behaviour of their superiors (mistrust and excessive control) as a reason for the lack of authority to take decisions (see chapter 2.2, page 57 ff). These results show that technical staff in the coal mines are able to make a realistic estimate of their situation and recognize structural deficits. To the extent that they believe personal shortcomings on the part of their superiors responsible for restrictions in the working situation, they are generally working at pits where traditional management attitudes on the part of the works administration and pit management in fact highlight the negative effects of organizational shortcomings; in this respect, the views of the persons interviewed and the results of our observations coincide.

Interestingly enough, the interviewees who consider their freedom of action inadequate consider the cause to lie in the management attitudes of their superiors four times more frequently than technical staff who are satisfied with their decision-

making latitude. On the other hand, the persons who are satisfied with their decision-making powers refer almost three times as frequently as their dissatisfied colleagues to the fact that technical factors limit their own freedom of action by imposing working rhythms (see chapter 2.2, page 61 ff). It is not clear how this result should be interpreted : are the technical staff satisfied with their decision-making freedom because they detect the influence of technology on their work situation but realize that they cannot change it ? In this case, satisfaction with their decision-making powers would be a result of resignation. On the other hand the views of the persons interviewed may also be explained by a realistic assessment of their situation; greater decision-making powers would in this case not be called for because the process and effects of technical development are recognized but considered inevitable and impossible to influence. We tend to consider that the two aspects - resignation in the phase of technical developments and also a certain realism in estimating the work situation and its development prospects - tend to persuade technical staff to accept that the extent of the available decision-making powers is satisfactory.

Finally, criticism by technical staff of the operational information system is widespread. Every third interviewee believes that he is given less information than is necessary to perform his tasks and a further 40 % report that they are only given the absolute minimum information needed to discharge their duties. As in our assessment of the available decision-making latitude, it is also apparent in our

appraisal of the information arrangements that the opinions stated vary less as a function of the position in the hierarchy than on the basis of the particular pit in which the persons concerned work (see chapter 2.2, page 75). The relationship with the organization of the decision-making processes in the pits is clear : strong centralization of operational decisions at pit management or even works administration level and frequent direct intervention by the latter in the administration of the areas are clearly correlated with a centralization of operational information at the top of the hierarchy. Technical staff are aware of this relationship and able to articulate it.

However clearly technical staff criticize the structural deficits, organizational shortcomings and inadequate management conduct by their superiors, they still generally have a positive opinion of their immediate superiors. In all the pits, the positive assessments of the conduct of direct superiors far outweigh negative views (see chapter 2.2, page 114 ff, in particular pages 118/119) : on average, two out of three technical staff consider a natural conversation with their superiors possible (page 125). This result shows in particular that despite all operational friction and difficulties and despite organizational shortcomings, the direct relationship between superiors and persons lower down in the hierarchy is still often intact. It must, however, be noted that this positive result was obtained in a survey in which persons who are already responsible for others were asked for their views on their own superiors; information on the actual attitudes of superiors and the prevailing working climate could

only be obtained by including workers as well in the survey. Finally, it should be noted that at three out of four pits at which the survey took place, there was a differing trend towards collegial cooperation (mostly in cases where the internal equilibrium in the hierarchy between operational and area management had an organizational basis) and that we also found a fourth pit where cooperation between technical staff was mainly characterized by receiving and passing on information and instructions (see chapter 2.2, page 119).

To sum up it may be stated that in all the pits, relatively important difficulties are experienced in the social mastery of technical, organizational and geological problems arising in the working process. These difficulties may be explained to some extent by the fact that the organizational requirements and qualifications for appropriate cooperative problem-solving methods are still lacking. Typical recurrent faults are :

- Personalization of problems and their causes.
- Frequent use of short-term strategies to solve problems.
- Lack of preventive fault-tracing methods.
- Predominance of individual rather than group decisions.
- Lack of subsequent behaviour analysis and correction.

A remedy can only come from the strategy which views organizational adaptation and an improvement of organizational and management qualifications on the part of technical staff as complementary factors and uses them as such. The general direction of the necessary organizational improvements may be characterized in this connection as:

- Decentralization of operational decisions.
- Strengthening the autonomy of working groups.
- Stabilizing the equilibrium of hierarchical structures.
- Institutionalizing horizontal forms of cooperation in line with the increasing differentiation of the production processes.

At some pits, organizational innovations have already been introduced with this aim in mind : the positive effects of these measures on the working cycle, job satisfaction and working results are shown in this report.

3.3 Training and further training of technical staff

A majority of technical staff have grown up in mining areas and almost half of them come from families in which the father was a mine worker or member of the mine staff. The early acquaintance with mining activities facilitates professional socialization and adaptation as well as familiarity with the working conditions in the mining industry.

In recent years, a different recruiting tendency has

appeared : technical staff come less frequently from mining areas and their fathers belong more frequently to other occupation groups. Especially in a situation of full employment, the training and working conditions must take account of changed demands and expectations, especially when we remember that 40 % of all the interviewees only decided in favour of the mines because they had no other job opportunities.

2/3 of the technical staff have completed primary school, one quarter have a lower secondary education and 11 % a school-leaving certificate. The better their education the easier it is to rise to pit manager level.

Before joining the mines a third of the technical staff interviewed underwent training in other sectors; machine and electrical foremen in particular often gained their specialized training in other branches. 39 % of the technical staff began work in the mines as unskilled miners, a further 39 % as apprentices or trainees. About half the machine and electrical foremen began work in the mines after previous activity in another industrial sector. Only 7 % of the interviewees began work in the mines in a technical staff position; these 7 % consisted primarily of pit foremen and mine managers as well as persons holding staff positions or working in the mine survey and underground training departments.

Under favourable organizational conditions, technical staff can do their job without a complete mastery of the activities of the mine workers but they must be acquainted with the latter. However, the professional career of technical staff has up to now required in practice an average of 10 years

experience as a mine worker before further training or appointment to a technical position.

Because of this practice, technical staff attach much greater importance to their previous professional experience than to systematic training for technical and engineering functions. On the other hand, half the interviewees were dissatisfied with their level of training and would have preferred to graduate as certified engineers. 15 % of the technical staff have passed no examinations to become qualified foremen. 62 % have a traditional foreman's training, i.e. have taken an examination while 19 % are certified engineers and 4 % graduate engineers. The training level of technical staff below ground in the pits is therefore well above the training level of technical staff in the mechanical engineering production sector.

With their training, 50 % of the technical staff expect that they could find a job outside the mines; this is particularly true of the machine and electrical foremen. On the other hand, about half the mine technicians consider additional training necessary while up to 1/4 feel that they would need retraining. The easier it is for them to change from one sector to another, the more frequently technical staff in fact think of leaving the mines. Mining technicians frequently quote their highly specialized training as a reason preventing them from moving to another sector.

40 % of the technical staff say they are satisfied with their training. The remainder criticize above all the fact that their training is not sufficiently close to practical requirements, while 14 % complain that they were not allowed to think for themselves in their training.

The higher the demands at the workplace and the more negative working conditions are felt to be, the more sharply training is criticized. The assessment of the individual workplace shows characteristic features for each pit. In general, the physical and nervous strain is considered very high while further training and promotion prospects as well as the training of workers are seldom viewed in a positive light. The workplaces of technical staff are viewed most favourably at pits 1 and 4 while the working conditions for them below ground in pits 2 and 3 are considered unsatisfactory.

In general, the previous training and cooperative activity enable half of the technical staff to pursue their activities in the different positions after a six months period to accustom themselves. However, 1/4 of the interviewees requires more than one year for adaptation.

Depending on the practices of the previous pit owners, 20 to 30 % of the technical staff of Ruhrkohle AG consider that their management had a positive influence on their training. An overwhelming majority considers that the methods of training technical staff have not changed.

A quarter of the technical staff view occupational training as a life-long learning process. This is taken into account above all in the form of professional experience but 3/4 expect a systematization, e.g. through activity as a technical staff member in various pits since they are at present dependent for their

adaptation primarily on discussions with colleagues in the plant who impart new knowledge as multiplying factors through vertical communication along the hierarchy.

Systematic further training opportunities are offered in varying degrees to technical staff in the different pits. While further training facilities for technical staff scarcely exist within the pit framework, opportunities do exist outside the actual pit. More than half the technical staff have not yet participated in any further training course. At no pit is even a quarter of the technical staff convinced that all staff have an opportunity to participate in further training courses. More than half the interviewees are not aware of the selection criteria for participation in further training programmes.

The further training requests of technical staff are closely connected with their activities so that further training measures should be organized in immediate contact with the technical staff themselves. Apart from activity-related further training, the possibility must also be provided to acquire general knowledge and basic natural scientific training in order to make good existing educational shortcomings.

This study has shown that training and further training

problems cannot be discussed in isolation from existing organizational structures and work organizational arrangements. Close on 90 % of the technical staff interviewed call for greater participation and involvement in decision-making processes in order to use their existing qualification potential in their activities. The high level of organization of technical staff in the mining industry and the general readiness of 3/4 of the technical staff to strike could where necessary lend the necessary emphasis to their wishes and expectations.

Secretariat of the Community Ergonomic Research
P.O. Box 237 - Luxembourg, Tel. : 288-31 (247-239)