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M E M O R A N D U M

ESTABLISHMENT OF A FOURTH E.C.S.C. PROGRAMME
ON ERGONOMICS FOR THE STEEL AND COAL INDUSTRIES

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Memorandum

Establishment of a Fourth E.C.S.C. Programme

on

Ergonomics for the Steel and Coal Industries

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I. Introduction

The Third Programme of Ergonomics and Rehabilitation (1974-1979) in the steel and coal industries, approved by the Commission of the European Communities on 2nd December 1974 pursuant of Article 55 of the E.C.S.C. Treaty, has now come to its end. The 9 million units of account made available for the programme and for the dissemination of the results have been committed.

The bulk of the aid allocated has allowed ergonomics action to be undertaken directly in the enterprises of the steel and coal industries and in a number of cases made it possible to achieve immediate application of research data : leading to an improvement of environmental and working conditions. Certain basic research topics were also financed in university and research institutions and a number of projects explored the contribution ergonomics can make to the rehabilitation of disabled workers to normal working conditions in as much as the two topics have common ground as part of the effort to adapt the workplace to the worker.

The application of an ergonomics approach to health and safety in the coal and steel industries was begun by the Commission in the programme "Physiology and Psychology at Work" (1964-1969) which followed a preparatory programme "Human Factors and Safety" (1957-1963). These programmes principally dealt with human reliability in systems and its improvement through training : and the development of protective equipment to meet the special requirements of the steel and coal industries. But they also saw the beginning of work on improving specific workplaces in the industries through the application of ergonomics principles and data.

The Third Programme has specifically developed this latter aspect through a programme of Community Ergonomics Action in the industries.

In the programme of Community Ergonomics Action the financial assistance available has allowed the industries to tackle a wide range of problems.

Considerable effort has been put into the protection of workers in both industries from unacceptable noise exposure. Tasks which have been examined in this respect are sawing, shearing and scarfing in the steel industry : and in the mines, noise from ventilation fans and from coal winning equipment has been investigated. Results have been encouraging with reductions of 3-8 dbA achieved in situations where ambient noise levels are between 90 and 100 dbA. But the aim is to bring the noise exposure to within acceptable levels. At the plant level noise control has been studied in rolling mills, in finishing shops, in the immediate vicinity of electric arc furnaces and in coal preparation plants. The solution to the problem here seem to be pointing to the provision of noise free havens. Associated with this area of investigation the problem of auditory communication and signals in mines has been studied.

Underground illumination has benefited from work in the programme, particularly facelighting. The requirements for this aspect of underground lighting have been established and it would be possible to produce standards for the industry.

The industries gave a high priority to continuing studies on heat stress and work load. This has developed with respect to better techniques for indicating the load imposed on the worker by hostile thermal environments and a better understanding of the limits of exposure and the way job organization can alleviate the stress.

Various studies on mining equipment have produced recommendations on standard ergonomics questions such as the design of controls, seating, posture, visibility, physical effort etc. Particular attention has been given to materials handling equipment and one project has begun work on the development of aids for particularly strenuous work in mining materials handling.

The ergonomics of personal equipment did not figure significantly in this programme. An important project, however, has provided an ergonomics evaluation of a recently invented "Air Stream Helmet" which gives protection in noxious environments. The incorporation of the ergonomics recommendations in future models should enhance the wearability acceptance of the device.

The interest of the industries in the broader ergonomics questions posed by a changing technology and increasing large scale automation began to appear in this programme. One project was devoted to a study of the problems in an automated hot strip mill which clearly indicated the need for further work.

In parallel with the programme of Community Ergonomics Action a smaller research effort has been carried through with the assistance of research institutions which, although mainly outside the industries, have co-operated with various steel and coal enterprises.

This programme has allowed work to begin on some pressing requirements for basic data on the effects of interacting psychological/physiological loads. The results have shown where future work should be carried out.

A number of projects on information displays for process control as they are being used in the steel industry have provided a design checklist for ergonomics acceptability for such displays.

An improved method of measuring the physical load imposed on the human biomechanical framework when a worker is engaged in materials handling has allowed significantly improved data as to the maximum permissible loads for human pushing, pulling and lifting for the age - range of the male working population : a particular feature is data on physical effort in these tasks when working in a restricted physical environment.

Some fundamental research has been carried out on human response to spot cooling after heat exposure. The results will give indications as to the acceptability/efficiency of such methods of recovery. With a view to making improved techniques available the physiological significance and measurement of thermal fluctuations at work has been studied.

Some basic research on noise and communication has also been part of this programme.

A small sector of the research programme has investigated the contribution that ergonomics can make to rehabilitation. The studies have allowed a global model of rehabilitation in the Community and in a national steel industry to be drawn up and from this the possible contribution of ergonomics should be identifiable. Clearly evident has been the possibility of using ergonomics techniques and principles in the assessment of the injured worker and to define the task to which he may return. A number of projects have been supported to give more precise information on this question.

Conforming to Article 55 : 2 c : § 2 the results of the IIIrd Programme as outlined above, and their possible application in the coal and steel industries, will be presented at a series of Information Days planned for Autumn 1980.

II. The Need for the Proposed Programme

Drawing on the experience of previous programmes, the Third Ergonomics-Rehabilitation Programme launched a major ergonomics contribution to improving health and safety in the steel and coal industries of the Community. Despite the readily apparent successes and improvements in the working environment achieved by the programme, the problems identified and tackled cannot all be regarded as having been finally solved.

In the main, the programme dealt with a batch of long standing health and safety problems and attempted to apply "corrective ergonomics" solutions to them. In some cases the application has achieved the desired result. In other cases, for example underground illumination, the work requires to be continued to have complete solutions to all the problems posed. In yet again other cases, further work will allow the refinement of the solutions arrived at during the Third Programme, for example in the case of haulage and materials handling.

The most effective use of ergonomics is, however, at the design stage so that problems of environment and working conditions do not in fact arise. Further ergonomics action where new plant and equipment are being proposed would be essential in helping the industries achieve their aims with regard to environmental and working conditions.

The contribution of design ergonomics will be particularly important where technological change is taking place, creating new tasks and new physical and social environments. Continued ergonomics action in the industries can assist in preventing a whole new class of hazards to health and safety which the new technologies, particularly automation, may bring with them.

The increasing general demand for an enhanced quality of working life will require the coal and steel industries to make greater efforts in improving working conditions and environment than those required in the more conventional factory situation. Continued ergonomics action will assist in these efforts.

At the Community level and in individual member countries standards are being laid down with regard to aspects of work organization, conditions of work and the working environment. An ergonomics effort will assist the steel and coal industries in meeting such legal requirements.

In the Third Programme, ergonomics action was backed-up with a modest research programme. To sustain future ergonomics action a programme of research of at least the same level is required. This programme will ensure that ergonomics action has the latest techniques and data available to attack its problems.

With these considerations in mind the Fourth Programme of Ergonomics will have the following objectives :

- (i) continued improvement of the general working and environmental conditions;
- (ii) ensuring that new technology does not create hazards for the human operator which would ultimately reduce its effectiveness;
- (iii) assisting the steel and coal industries to meet the demands for a better quality of working life;
- (iv) assisting the industries to meet legal requirements concerning working and environmental conditions;
- (v) ensuring that the action towards these aims is supported by the most up-to-date ergonomics techniques and data.

III. The Programme

1. Community Ergonomics Action Programme

The Community Ergonomics Action Programme will aim to put into practice the vast body of basic ergonomics research data which is available from the general literature, including previous E.C.S.C. research programmes, for the purpose of improving the safety and health prospects of the workforce of the steel and coal industries of the Community. The work carried out will lead directly to achieving this aim. It will be undertaken by the ergonomics groups and departments which now exist in the two industries.

It will be directed primarily towards improving the design of new plant, equipment and production systems and physical environments in these industries wherever possible and to a lesser extent to the application of "corrective (remedial) ergonomics" to existing equipment and systems. In this fashion human factors and engineering will go hand in hand in an advancing technology which is intrinsically safe and healthy. The programme will aim towards harnessing in a joint effort the expertise which has been built up in the industries during the previous programme to achieve these aims by encouraging and giving priority to proposals calling for co-operative projects at the company, industry and Community level.

Specific aspects of the work to be carried out are as follows.

1.1. Automated Systems, Process Control and Communications

Progressively more mining and steel making operations are being subject to some degree of automation or, while remaining mechanical/manual, are monitored and controlled from remote control centres (using television and/or complex electronic "state" displays with their attendant emergency displays). The task performance of the operator in these systems is dependent on his ability to conceptualize and make judgements on a real physical situation from the numerical, symbolic or pictorial displays presented to him. These new conditions demand an ergonomics consideration of the interaction of the operator and his task to ensure that the safety of the total system is not put at

risk by a mismatch between the design of the control/information system and human capacities for processing such information over varying load conditions and prolonged time periods : or by the job design and social environment often created by such systems.

Communication by radio and telephone systems increases with the development of the centralised process control and management information approach. This creates its own set of potential hazards as the risk of misinterpretation by these indirect methods is higher and is exacerbated by the increasing variety of ethnic groups in the working population of the two industries.

The present programme will support the study and development of ergonomically acceptable process control and communication systems.

1.2. Production Plant, Equipment and Tools

In both the coal and steel industries, plant, workplace, machinery and tool design still pose many ergonomic questions for solution with respect to health and safety.

In mining for example, it can be seen that, on the one hand, the utilization of equipment, in tasks such as setting and advancing supports in the roads or setting coal-winning machinery at the face, will continue to be associated with large muscular efforts, difficult postures and intermittent physiological overloads : while on the other hand, modern coal-winning equipment is attaining a level of sophistication where the relationship between the operator and the control of the machinery pose new questions for safe and efficient working.

Apart from heavy machinery, the smaller, hand tools used in the industries, for example the pneumatic drill as a source of severe vibration exposure, are potential health and safety hazards without an ergonomic evaluation.

1.3. Haulage and Transport Systems

Haulage, transport and material handling continue to be a significant cause of injury. The Third Programme of Ergonomics included several studies on these problems which indicated that ergonomics factors such as visibility, control layout, seating and vibration in transport systems, methods and lack of aids for physically arduous work, were possible contributory factors. Further studies will provide ergonomics specifications for the new design of materials handling and man-riding vehicles which will come into service in the future : and will consider the ergonomics contribution to alleviating physical load and reducing safety hazards in materials handling.

1.4. Personal, Protective and Safety Equipment and Clothing

Much of the personal, protective and safety equipment and clothing used in the industries has been intrinsically modified over the years to current designs which prima facie have a high level of effectiveness but a lower level of acceptability. Their design in relation to work postures, task design, environmental conditions and accident risk, for example, do not appear to have been systematically considered. The inter-relationship between these factors and the design is a possible contributory factor to non-use and the bad practice associated with such equipment and clothing.

Also new items of specialised equipment are always being introduced, for example, to combat noise or atmospheric pollution hazards. There is a need for an ergonomics contribution to the design of such items to ensure their efficiency, acceptability and use among the workforce.

1.5. Thermal Environmental Load

Physical load as a result of a hostile thermal environment continues to be a significant factor in the operation of the two industries. There is a need for continued work on this problem in relation, for example, to the combination of thermal stress with other environmental hazards or job design. Attempts will be made to alleviate the physiological loads brought about by such conditions by, for example, the specification of critical limits of exposure for particular tasks, task design, or job organization.

1.6. Illumination

In the steel industry ambient illumination poses few ergonomics problems. Specialised lighting, for quality control inspection for example, can still, however, benefit from ergonomics interventions. Similarly in mining, significant advance were made during the Third Ergonomics Programme with regard to the general ergonomics principles of underground ambient illumination. But further work is necessary to define the ergonomics parameters for specialised local illumination : for example, the miner's personal lamp. Such work will be pursued as necessary in both industries in the present programme.

1.7. Noise

Much work has been completed in general and in previous E.C.S.C. programmes on the ergonomics aspects of noise. The current situation is that questions of providing protection from noise by action at the source is now largely a matter for technical intervention and this aspect of hearing conservation activity is dealt with in other E.C.S.C. health and safety programmes.

There are nevertheless, noise situations, for example during maintenance tasks or in coal preparation plants, where noise exposure cannot be reduced easily by direct design methods. Other alternatives for controlling noise-induced auditory damage in such

situations need to be explored. These special problems will be taken up in this current programme. In addition there is a requirement for investigations aimed at producing representative findings on causes and effects of auditory damage in steel plants.

1.8. Group Differences

The workforce in the industries cannot be considered a homogeneous population. Apart from individual differences, which go beyond the scope of realistic ergonomics consideration, there are group differences brought about by injury, increasing age etc. which should be considered in ergonomics terms in order to enhance the health and safety prospects of such groups in an essentially normal working situation.

This programme will encourage and support work on the ergonomics factors in the specialised questions of rehabilitation of injured workers to the normal working situation and similar questions which arise in attempting to take account of the needs of special groups in the workforce.

2. Ergonomics Research Programme

The purpose of this programme will be to sustain the data needs of ergonomics action in the steel and coal industries : currently, where basic knowledge on human performance is required for on-going ergonomics action : looking to the future, where such knowledge will be necessary as new systems, plant, equipment and working methods are introduced in line with the industrys' investment plans.

While based on the industrys' needs and implemented wherever appropriate within, or in direct collaboration, with the industries, the programme will nevertheless be concerned with the general pool of fundamental problems which require elucidation on human physiological and psychological capabilities and performance as they are related to ergonomics. To this end it will embrace both field and laboratory research as necessary. University and Research institutions whose interests and competence make them potential contributors to achieving the Programme's aims will be invited to participate in the research work.

The specific fields of research to be covered in the programme will be as follows.

2.1. The Evaluation and Assessment of Psychological (Mental) Load

The immediate questions for ergonomics action in relation to automation and process control activities in the steel and coal industries generally can be met by the available knowledge on human capabilities for predominantly mental work and the critical factors in creating over-load.

Further effective action, however, will have need of much more detailed research data on human performance and recovery when tasks are such that intermittent or high or low levels of mental (psychological) activity are combined with high levels of physiological load imposed by physical effort, extreme environments, or some aspect of work organization, such as shift-work or night-work : or are combined with some aspect of the job design as boredom, monotony or impoverished job content.

There is also a need to develop more robust and valid techniques to evaluate mental load, particularly in field conditions.

The programme will pursue basic research on these topics.

2.2. Protection and Recovery from Thermal Stress

Exposure to high temperatures will continue to be a feature of working in the two industries. Thermal conditions may possibly become more extreme in the coal industry if coal-winning progressively demands exploiting seams at greater depth. In such extreme conditions questions such as limits of exposure-time may become more critical as they reach a lower limit incompatible with a realistic working schedule. A better understanding of the timing of rests pauses and

the optimization of recovery periods is required. Further in an effort to improve the applicability of current heat stress data there is a need to develop realistic weightings for a broad range of working conditions. In addition more direct methods of protecting operators and facilitating their immediate recovery after a period of exposure to high temperature conditions are possible. More data is required however on the human physiological response to the various possible materials and techniques which could be incorporated into such protective and recovery systems.

The programme will take up the relevant research questions in the context.

2.3. Protection from Biomechanical Damage Risk

Because of space restrictions and an unconventional workplace the miner is at greater than normal risk to biomechanical strain leading to lumbar disorders or serious damage to limbs. Thus, an important ergonomics consideration in the design of equipment and tools for the mining industry is accommodating abnormal working postures.

The problem, however, is not confined to the coal industry. The high incidence of lumbar disorders in the steel industry has been identified with stressful postures occasioned by workplace and equipment design. Ergonomics action will have the increased possibility of reducing health hazards in this area if more precise data is obtained on the basic capacity of the human biomechanical systems for producing external forces (pushing, pulling, lifting etc.) with regard to posture and age, for example : and on the aspects of tasks in the industries which create lumbar disorder or limb-damage risks.

The programme will initiate the necessary research to obtain this data.

2.4. The Ergonomics Contribution to Rehabilitation

The Third Programme of Ergonomics identified the limits at both the national and industrial level within which ergonomics could make a contribution to rehabilitation of the disabled worker.

This contribution is incorporated in the ergonomics action section of this programme. For the ergonomics action to be effective it will be necessary to re-define the criteria for the functional evaluation and assessment of the capacities and aptitudes of the disabled in ergonomics terms : and where necessary to evaluate, in ergonomics terms, techniques and methods of rehabilitation giving due regard to the fact that this impairment may be physical, physiological, psychological or social.

The programme will support research work on these specific problems.

3. Selective Studies into Special Aspects of the Ergonomics Contribution to Safety and Health in the Steel and Coal Industries.

Relatively small, but often important and interesting, problems in ergonomics or its application are raised in the course of the work of industrial medical officers, safety officers, training officers and others associated with ergonomics action. Where the solution of such problems are of interest to furthering the aims of ergonomics action or research, the programme will support and, if necessary, initiate small selective studies.

IV. Co-ordination of the Work

During the IIIrd Ergonomics Programme, national ergonomics teams were established throughout the two industries. The ergonomics teams have among their activities coordination of the Community Ergonomics Action projects within their national industry; and, with the assistance of a central Secretariat for Coordination and Information Dissemination, the coordination and liaison with other national teams and an Expert Scientific Advisory Group at the Community level. Through this network, the Expert Group have successfully co-ordinated the promotion and development of Community Ergonomics Action projects within the IIIrd Programme. The same network will be available for the IVth programme : and will be strengthened by the reconstitution of the Expert Group as the "IVth E.C.S.C. Ergonomics Programme Committee of Scientific Experts" incorporating representatives of all the national ergonomics teams of the steel and coal industries.

The IVth E.C.S.C. Ergonomics Programme Committee of Scientific Experts will also undertake the co-ordination of the Research Programme through working parties on the themes of the programme : on the basis of information available from the semestrial technical reports submitted to the Commission as a condition of contract ; and from direct contact with the researchers at meetings convened in Luxembourg or at the Research Centres as necessary.

The Commission will be advised on the scientific/technical aspects of the promotion of all individual research projects in the IVth Programme by this same Committee of Scientific Experts. Subsequently it will be advised on the views of the social partners concerning these projects by the Committee of Producers and Workers for Industrial Safety and Medicine, primarily through the Sub-Committee of this group. For the Research Programme the Commission will be further advised on individual projects by a Committee of Government Experts whose members are suitably qualified.

Giving due regard to the fact that the relevance of projects within the Action Programme is generally limited to the E.C.S.C. industries and the need for a rapid implementation of projects in the Action Programme this pattern of consultative procedure has been found to be the most effective in previous programmes.

V. Research Results

The network of ergonomics teams, Secretariat for Co-ordination and Information Dissemination and Expert Group for Community Ergonomics Action mentioned in Section IV has proved an efficacious channel for quickly disseminating important findings, current progress and developments in the Action Programme and in the Research Programme to the appropriate sectors of the industries by means of a quarterly Information Bulletin, special reports and information meetings for team representatives. It is envisaged that the same information flow system would be used in the current programme.

Outline final reports of the projects and, where necessary, synthesis of groups of projects will be drawn up and disseminated to the relevant sectors of the industries and the Commission.

For a wider public, information on the initiation and final results of projects will be presented in "Euro-Abstracts".

The complete final reports will be available on request from the Commission to interested organizations and individuals.

In a significant number of cases information on the results will be available in the open scientific/technical literature.

At the conclusion of the programme the results will be presented to the steel and coal industries during a series of Information Days.

VI. Financial Aspects and Duration of the Programme

The Third Ergonomics-Rehabilitation Programme ran for five years. This has proved sufficient for positive results to be drawn from the projects, and in some cases to apply the results.

The projects have usually lasted three years, as will be the case in the present programme, which it is proposed will run for five years.

The funds to be allocated for the programme include not only the financial aid for the projects but also the related costs of implementing the programme and disseminating the results, as well as the costs of publication, translation, typing, distribution media, etc.

In assessing the funds required, account has been taken of the cost of previous projects, average cost increases, the annual budget for social research in the coal and steel sector, and the equipment required by institutions and individuals for the satisfactory organization of the programme.

In view of the above and the fact that Community financial aid does not usually exceed 75% of the direct costs of the projects, the remainder being met by the beneficiary, it is felt that to implement a satisfactory programme which will make an effective ergonomics contribution towards improving industrial safety and health in the E.C.S.C. industries, it is necessary to allocate funds amounting to 13 million E.U.A., spread over 5 years from 1980 : these being required as follows :

Community Ergonomics Action	8	million E.U.A.
Ergonomics Research	4	million E.U.A.
Selective Ergonomics Studies	.5	million E.U.A.
- Operating Costs	.5	million E.U.A.

VII. Conclusions

The Commission of the European Communities

- considering the need to encourage ergonomics action in the E.C.S.C. industries, and to promote ergonomics research appropriate to this action, for the improvement of health and safety in these industries;
- taking into account the favourable opinions and agreement expressed by expert , industrial and government consultative committees;
- having regard to Article 55 of the Treaty establishing the European Coal and Steel Industry;

proposes to launch "A Fourth Programme on Ergonomics for the Steel and Coal Industries" for which the total cost is estimated at 13 millions eua over a period of 5 years beginning in 1980.