ASSET MANAGEMENT IN THE UK COAL INDUSTRY

By

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INTRODUCTION

British Coal has always been a big mining company and its management has been beset with many of the problems one would associate with such an undertaking. These include its accountability to Government, its market vulnerability to competing fuels and to imported coal and its relationship with its workforce but also with its own history and size.

As a fragmented private industry up to and including the Second World War, it was starved of capital and its management developed an historic relationship with its workforce which was often counter-productive to success. Once nationalised, it contributed greatly to post-war industrial regeneration. Investment was forthcoming to reconstruct existing mines, sink new ones and to mechanise production operations. British manufacturing companies contributed to this mechanisation drive, the very success of which drove up production and productivity and against a declining market, contributed to the reduction in size of the industry.

Production machinery design evolved in the 1960s with close collaboration between manufacturers and users such that an inevitable proliferation of machinery types and specifications developed to meet local needs.

Longwall mining internationally outside Western Europe only became significant in the 1970s. It became apparent that international operators demanded higher levels of plant performance from British manufacturers than British Coal did. This was the birth of the “heavy duty” plant concept. As international performances outstripped our own then British Coal moved in to invest in itself, in this heavy duty. This re-investment commenced in the mid 1970s but only gained real momentum in the 1980s when it became a virtual re-equipping exercise for the whole industry.

British Coal has reassessed its technical policy in the last two years in the light of an overriding need to contain and reduce operating costs. The objectives of technical policy can be summarised as follows:

1. to increase the reliability of new and existing equipment through the introduction of technical improvements, the use of performance-based specifications and its correct applications;
2. to improve maintenance systems through increased condition monitoring;
3. to rationalise the proliferation of machine types;
4. to improve plant utilisation;
5. to identify and foster the introduction of heavy-duty face equipment;
6. to rationalise the organisation of equipment repairs.

HISTORICAL BACKGROUND

Since 1967, the Corporation’s stock of underground mobile machinery assets have been managed by an internal hire system, known as the Plant Pool; each administrative (and geographical) Area of British Coal having its own support of equipment to service the needs of its collieries, and particularly its coal faces. Plant was also acquired by each Area based on its own perceived needs, which to a certain extent were prioritised on maintaining the size and quality of the pool.

The Pool hired plant out to the user collieries and arranged for ‘dirty’ or used plant to be sent either to workshops or to outside contractors for repair. The Pool stored plant either in clean or dirty condition on behalf of the collieries and operated the back-up system of emergency support in the event of breakdowns happening. A recent survey has shown that the annual costs of this exercise nationally were as follows:
Repairs and Materials $234.0M
Depreciation $109.6M
Other expenses incl. plant hire, salaries, etc. $4.9M
$349.5M

At the end of 1987, the Plant Pool system included over 296,000 items of plant (both total machines and sub-assemblies) in the following categories:

- Power loaders
- Roadheading machines
- Coal and stone loaders
- Belt conveyors
- AFC and stage loaders
- Power packs
- Powered supports
- Transformers
- Portable haulages
- Free steered vehicles
- Electric motors
- Gate and switchgear

Hire rates were set locally between the pool and collieries to cover the depreciation charges associated with the holdings in the pool and also the total cost of repair and management of the pool.

Equipment purchased in the categories above was all capital with a depreciation period of eight years irrespective of the plant. Sub-assemblies of complete machines in these categories were all treated as individual capital items. Capital is allocated to the Corporation each year by Government and split into Area allocations, according to need by the Corporation, Area Directors and their team then further sub-divide it for different uses.

In August 1987, the Technical Director of the British Coal Corporation formally wrote to the Directors of all eight Areas of British Coal explaining to them the changed financial arrangements for the purchase of new plant after 1st April 1988, and the changed status of existing plant held at collieries after that date. This letter represented the first formal step in a process known locally as 'de-pooling', a strategy whereby the existing underground machinery asset management system, known as the Plant Pool, would be replaced by a new system based on ownership of assets by individual collieries. Until this letter was sent out by the Technical Director, there were separate branches of expenditure for replacement plant and for shield powered supports. This has since been changed in the light of change in the technical policy and system of plant management.

It is worth noting at this point that at the time the Plant Pool system was set up, British Coal, then the National Coal Board, operated 378 collieries with 1,196 mechanised coalfaces in 17 Areas. Today the industry has reduced in size considerably to 102 collieries, 278 coalfaces and 8 Areas.

Expenditure on capital equipment has always been substantial within British Coal as it has first mechanised its coalface operation, and secondly introduced more 'heavy duty' equipment to update its equipment holdings. The following table gives an analysis of the value of equipment purchased since 1981.

Perhaps the most significant feature of these figures has been the increasing proportion of capital spent on shielded powered supports, for it has been the policy of the Corporation to introduce shield technology into as wide a range of seam sections as possible. At present the Corporation owns some 180 sets of shields and continues to invest in them at the level of 25-30 sets per annum.

However, it has been recognised that, especially in the seam sections below 1.5m where some 200 faces produce 35% of British Coal's deep mined output, shield supports alone do not guarantee the levels of productivity and the return on investment that the Corporation requires. It is clear that the total mining system of power loader, AFC and powered supports should be compatible and capable of producing coal at levels which give an adequate return.

Since the introduction of the heavy-duty programme, output per face day from faces equipped with heavy-duty shield support and a more modern power loader have improved markedly. An example is illustrated of one of the newer mines Wistow Mine within the Selby complex of up-to-date performances adopting the policy of heavy-duty equipment compatible within a system. Wistow was, in fact, the first mine to start producing coal from longwall faces within the Selby complex.

In the early stages of production severe problems were encountered due to an ingress of water and heavy rock loadings on the powered supports. The mine layout which had originally been planned to operate on 140m long retreat units was then further modified to operate on 70m long single-entry units to reduce the effect of water ingress and rock loading since commencement had already been undertaken with both the powered roof supports and the face machinery. Following detailed investigational work, the single-entry panels had to be reduced to 35m in length. This represented a substantial challenge to the mine operators within the Selby complex as there was the opportunity to move to more conventional lengths of retreat faces would not be available for at least two years. These single-entry panels have demonstrated the
justification in heavy-duty investment, with peak performances realizing 27,000 tonnes/week and an output per manshift in excess of 200 tonnes.

With this operational experience on the very short faces, the introduction of the first 4m retreat face was approached with a degree of excitement to exploit the potential of the available face room. The best week's performance to date from the 175m of face room available at Witsow has returned in excess of 68,000 saleable tonnes.

These higher levels of performance from the retreat coal faces presented the mine with a new challenge, the challenge of face replacement and accelerated development performance. It is sufficient to state at this stage in the presentation that the challenge has been adequately met with average performances in development drives in excess of 160m per week. Almost coincidental with this investment in heavy-duty equipment and the subsequent improvements in performance has been the marked general improvements in performance nationally since the major disruption and strike of 1984/85.

Improved co-operation of the workforce has seen improvements in productivity approaching 60% over the past three years, with output and productivity performance targets regularly being beaten in each of the coal field areas. It should be remembered at this juncture that this is against the background of old deep mines with the attendant infrastructure problems.

It is appropriate at this stage of the paper to consider the importance of equipment reliability in British Coal, the emphasis that is now being placed upon it and the measures being pursued to develop techniques of condition monitoring.

Like many aspects of the British mining industry, the maintenance of mining equipment has a historical perspective. The duties of colliery engineering staff with respect to maintenance procedures are firmly established in legal statutes which provide for a system of time based maintenance to be established. This is known as "The Managers Scheme for the Mine".

The scheme includes checklists which contain detailed requirements for examination and tests of equipment at intervals specified by the mine manager (obviously after consultation with his engineering staff). The detailed requirements may be contained within legal statutes, mandatory instructions from the Technical Director, codes and rules and information and recommendations circulated through engineering channels by HQ Technical Department.

Several problems arise from total reliance upon time based maintenance. It is expensive on manpower since physical examination can be lengthy and machinery has often to stand idle whilst it is examined. This can mean lost production or a significant overtime bill. It is also a fact that the period between periodic examination is one in which no condition-based information is being gathered and the incidence of unexpected failure can increase. It is also of some concern that the very act of making a detailed examination of a piece of equipment can lead to the components being disturbed or the ingress of dirt from the mine environment which, in themselves, can hasten failure.

It is for these reasons that British Coal have been involved in a considerable amount of work, mostly originating from its HQ Technical Department to develop a range of transducers suitable for use in routine condition monitoring. The techniques not only enable machines to operate at optimum performance with improved reliability, but it can also be used to establish trends in performance or deteriorations which can be used to predict failures (thus avoiding unnecessary breakdowns), fault diagnosis and equipment commissioning tests.

Examples of measurements taken include the...
Following:

- Electrical power input using power transducers
- Hydraulic circuit monitoring giving an assessment of pump, motor and control circuit condition
- Haulage forces and clutch setting levels on power loaders
- Oil debris analysis in gearboxes
- Bearing condition by shock pulse monitoring

It is also important that the data available from all the transducers and measuring techniques is handled in an orderly and sensible manner, such that reports can be produced for operating managers which highlight suspected problem areas. This requires correlation of information from a variety of services and the extraction of the anomalous reading; the one which demonstrates the trend such that remedial action can be planned with some evidence as to the suspected time of breakdown.

It is clear in the future that British Coal is likely to adopt, on a widespread basis, revised maintenance schedules at its mines, bringing together the best elements of both time and condition-based maintenance compatible with defined duty cycles for the equipment in use.

As the transducers were developed, the instrumentation in the mine was hand-held gathering test information to be analysed by trained engineers. A wider industry understanding of the information being collected and the ability to interpret the information led to its wider application within British Coal. This widespread application logically led to the use of condition monitoring equipment during the commissioning stages of all of the coalfaces in order to ensure that the installation had, in fact, taken place to designed limits and met with and agreed with manufacturers' specifications. Alongside the development of these transducers and the educational process taking place within British Coal, the development of the automatic guidance system known as MIDAS was taking place. This in fact is an on-board machine computer linked to the surface by a high speed data link and provided adequate capacity to add into the machine 22 such transducers as well as operate the steering function. The coalface machines today, therefore, which are equipped with such steering systems are also equipped with continuous on-board monitoring equipment. Development work is in hand at Headquarters Technical Department to integrate all of the monitoring systems which have been developed in order to bring to the surface collectively through SUMIT and MIDAS links, information which is of value to both management and engineers. This development is a logical progression from the FIDO systems applied in each Area of British Coal and with high-speed data communication highways, ICON links to surface computers and the development of gate and computers of higher power than those currently available, will progressively lead towards the integrated and maybe automated face.

Many papers have been published in the UK on this subject alone. My aim in raising it is to make you aware that plant management systems do not solely concentrate on the purchase, provision and repair of plant, but also include those which keep it running in optimum conditions whilst it is underground.

Mention has been made earlier in the presentation of the birth of mechanisation and its subsequent growth since 1967 which has of necessity led to the proliferation of various machine types over the 20 years experience of mechanisation within British Coal and to the inevitable situation of having a large variety of equipment to deal with site specific problems, particularly in the older collieries dedicated to advanced working methods rather than to retreat mining and the attendant complications of engineering the face ends. The problem, nationally, of changing from advance techniques to retreat type of mining is aggravated by the desperate need not only to break even, but to operate internationally at prices that allow us to remain competitive.

The problem facing colliery management is turning from advance to retreat is the apparent insurmountable problem of development drive. Progressively, and with persistence this problem is being resolved.

Current business plans within British Coal indicate that 60% of the coal mined in 1977/78 will be from retreat longwall which shows a growth in retreat from the current position of 37% of the production capacity from retreat over the forthcoming four years.

The progressive changeover from advance to retreat will simplify the engineering requirements of coalface design and in itself will help to reduce the existing proliferation of site specific equipment. Additional attempts are being made within the organization to rationalize designs of mining equipment in the form of the coalface shearer, the AFC, the powered roof supports and the face end equipment required to support the advancing longwall face. This has the two-fold advantage of reducing the variations of machines at work, but also simplifies the back-up requirement on support machines to keep the ageing fleet at work.
ASSIST MANAGEMENT

The Corporation has recently decided that changes are required in its practice and procedures for the management of its machinery assets. To this end it made a number of decisions which were designed to enable it to replace the national plant pool system with a more cost-effective means of control for modern specifications of plant.

The major elements of this changed system included:

- capital allocations
- heavy duty equipment
- capital/revenue code
- termination of plant pools
- the inception of product support
- increased emphasis on asset recording

As mentioned earlier in the paper, historically, the Corporation have had two categories for plant purchases, the 'heavy duty' category being used for shield powered supports and the 'replacement plant' category for 'top up' purchases for the plant pool. Under the new arrangements, a revised and limited range of designated equipment can be purchased under the 'heavy duty' heading and non-heavy duty requirements that remain can only be met from the 'others' category.

HEAVY DUTY EQUIPMENT

The Corporation have now recognised that the improvements in production and productivity that were experienced as a result of investment in heavy duty supports could be further enhanced by the application of modern designs of high performance, reliable power loaders and AFCs with appropriate switchgear.

It has been decided to define certain types of equipment as heavy duty and allow capital expenditure on these from within the 'heavy duty' allocation.

The 'old' approved plant pool equipment lists have been withdrawn and are being replaced by a list of equipment approved by the Technical District, on the advice of RCST, following extensive acceptance trials. Areas wishing to invest in heavy duty equipment under the 'heavy duty' capital heading, have to ensure that the investment:

(a) meets performance criteria laid down by the Corporation in its capital investment manual. At the moment one of these criteria lays down that the equipment must be capable of producing a minimum of 500,000 tonnes per annum;

(b) has a defined deployment for the period of eight years;

(c) is deployed at a colliery which meets certain financial performance requirements which at the moment are defined as capable of producing coal at no more than $1.50 per gigajoule and if it is for marginal output, should produce at no more than $1.00 per gigajoule;

(d) it has to be within the programme laid down and agreed within the Area business plan.

Any investment plans which fail to meet all of these criteria require to be submitted to the Corporation for approval and approval is only granted in exceptional circumstances. The unfortunate situation is that collieries who cannot meet all of these criteria will either install coalface from existing fleets of equipment or go out of business, or, if the investment can be justified for the life of the mine, then permission is granted by the Corporation for that particular investment.

CAPITAL/REVENUE CODE

The Corporation have agreed the following changes to the capital and revenue code from 1st April 1988:

(a) purchases of complete power loaders including the power loader underframe, and trim will be classified as capital expenditure;

(b) purchases of complete roadheaders, continuous miners, coal and stone loaders, free-steered vehicles's and similar machines including trim will be classified as capital expenditure.

(c) sub-assemblies required to support the power loaders, roadheaders, continuous miners, coal and stone loaders, free-steered vehicles's and similar machines will be classified as revenue expenditure;

(d) purchases of complete heavy duty AFCs including chainless haulage systems and stage loaders will be classified as capital expenditure;

(e) individual items costing less than $10,000 at colliery activities and will be classified as revenue expenditure; and

(f) depreciation and repair costs of capital assets used on capital works will be classified as revenue expenditure.

Currently major sub-assemblies of some machines, notably the power loaders and roadheaders are capital assets in their own right. Under the new procedures, these units
will initially retain their capital value until they enter the product support scheme, at which time they will be written down to stock and their separate capital identity will change. Complete machines should, in future, be considered and dealt with as 'assets'.

**TERMINATION OF PLANT POOLS**

The Corporation decided, that national underground plant pools should be disbanded with effect from the beginning of the 1988/89 financial year so that the responsibility for managing plant is devolved to unit management and the appropriate asset values are transferred to collieries. Thereafter, the depreciation and capital charges arising, and perhaps more importantly, the repair charges will be borne direct by collieries and national underground plant pool hire charges will cease.

Assets not held at collieries from 1st April 1988 will be dealt with in the several different ways:

(a) Complete machine assets can be held by areas at a location convenient to their needs but the depreciation for the asset must be borne by the nominated colliery for which the item is held. Some Area holdings of plant will still be retained in the short term where it is inappropriate to specify one particular colliery or owner.

(b) Complete machine assets not required by collieries will be transferred out of area control into a national holding of capital items withdrawn from use under the control of the Technical Director. Depreciation for these machines will be handled nationally. Redevelopment of these assets will be the responsibility of Headquarters Technical Department.

(c) The existing Repair and Renovation Scheme for small items of machinery will be extended to cover items reclassified as revenue expenditure, such as sub-assemblies required for most:

(i) power loaders;
(ii) roadheaders;
(iii) continuous miners;
(iv) coal and stone loaders;
(v) FSV's and
(vi) similar machines

The policy of the Corporation is that those back up assets both clean and dirty, now being brought into the Repair and Renovation System should be transferred to National Workshops at written down value. The items will be carried on National Inventories available for use at any colliery. Depreciation and capital charges on these items will cease.

**PRODUCT SUPPORT**

In order to minimise the holdings of back up equipment product support for colliery assets will be provided by:

(a) National Workshops in conjunction with central stores; or alternatively
(b) by the manufacturers.

The system works quite simply and is based on the existing Repair and Renovation Scheme for stock items. On issue of an item from National Inventories, collieries will be charged the full stock value equivalent to the cost as new. On return to central stores of a similar item requiring repair, the colliery will receive a credit being the full stock value less the standard cost of that repair; on subsequent repair the colliery will receive a supplementary debit or credit if the actual cost of repair is more or less than the standard. The net effect of these transactions is that the colliery is charged with the actual repair cost.

The National Workshops have been organised such that dedicated product centres for the country are now being established, and as they tend to be associated with central stores on the same site, it is expected that the majority of clean and dirty items from a product range will be held at these centres. However, provision will be made for physical holding points away from the product centre to deal with collieries geographically remote from the product centre. In this respect customer requirements will be given priority.

Items covered by the Repair and Renovation Scheme can only be acquired by issue from National Inventories. Clean unit stock levels will be agreed with the users. Clean units will be available from stock to meet users normal and urgent demand to support both operational faces and new face builds. Stocks of clean units will be accessible twenty-four hours a day, seven days a week.

Those items included in the Repair and Renovation Scheme will be repaired by National Workshops. Original equipment manufacturers are likely to be involved only in supporting new machines on Field Trials, or alternatively new machines of low fleet numbers, one-off machines and non-standard designs, except where existing contractual arrangements exist.

**ASSET RECORDS**

There is one very important feature of plant
management which must be maintained during the period of change and into the future beyond, that is, an adequate record of plant holdings.

DAPPER is the Direct Access Plant Pool Equipment Register and has been in existence since 1982 and used in all areas since 1983. It has two functions currently in plant management. It is a financial record of equipment holdings and is used to calculate and levy hire charges in the pool system. It has also now been adopted as the Corporation's Fixed Asset Record giving the book value of all capital plant. It is also a technical/physical record of the existence and location of plant.

DAPPER holds a record of plant holdings with an enquiry system, known as PROGE (Plant Register On-line System Enquiry) which allows interrogation of the records to be made. The database is contained within the Corporation's mainframe computer at Cannock, with terminals in areas allowing access to individual area equipment holdings, giving the ability to change those records as necessary.

It is intended to maintain the present DAPPER - Fixed Assets System linked to cater for the recording and control of de-pooled assets. The existing link already caters for acquisitions and disposals in that an entry to the DAPPER System automatically generates a corresponding entry to the associated financial record in the Fixed Assets System. The link is being developed to operate for block asset records, by category, on a unit-by-unit basis in contrast to the present Area block asset record. The enhanced link system will automatically record transfers between units, the trigger being a change in the "financial" location code in the DAPPER system, resulting in the corresponding transfer of the correct written-down value and depreciation life from the block asset at one unit to the block asset at the receiving unit.

The flexibility of the DAPPER System is being extended in order to make it suitable for use at collieries as well as area offices. A number of changes to the system will be completed and available for general use by the end of this financial year. These changes will allow, with adequate safeguards to the financial records, the following facilities to be available at colliery terminals.

(a) Enquiries - examination of plant holdings through PROGE.
(b) Equipment movements - a 'dual-entry' system between collieries in the same Area and between a colliery and a non-chargeable location.
(c) Instructions to workshops - CM43

documents.

(d) Reports - of movements of plant.

The more sensitive financial controls will remain away from collieries whilst the new plant management systems are established, staff are trained and the suitability of the DAPPER system to meet management requirements is assessed.

The recording and identification of equipment will become simpler when the main machine is categorised as one capital asset rather than a collection of capital and in some cases, revenue sub-assemblies.

It is clear that the system which is being established requires to fulfil a number of needs. It must be able to cope with breakdown situations in which a replacement unit of plant is required at any time of night or day. Secondly, as we do not yet transfer much of our equipment from face to face (except for the powered supports), it must cater for the acquisition and build-up of new face installations to be ready for the commencement of production. Thirdly, the accounting rules and recording systems, the administrative infrastructure of such a system, must be in place and working.

Because the size of the industry has reduced to more manageable proportions, it is possible that much of the decision making regarding plant specifications and the size of plant holdings can be made centrally allowing further cost savings through economies of scale in spares holdings.

THE FUTURE

I would like to close this presentation by attempting to look into the future, albeit the short and medium term.

British Coal may continue to decline in size, as increases in production and productivity at the coalface allow us to meet our market with fewer collieries and fewer faces. The size of that market is not fixed either and it is based very much on costs of production and our ability to maintain security of supply. One thing is assured though, we will still be a very big mining company. Our mines will go deeper, in excess of 1,000m, each producing 1.5 to 2M saleable tonnes per annum, (not to mention 1M tonnes of dirt in addition) from one or two faces in a multiple seam environment, served by two vertical shafts (many of which were sunk over 50 years ago).

We currently work seams between 1m and 4m in section and have only 35% of our faces on retreat. This percentage will increase to 60%
in five years, but this still leaves a significant number of advancing faces. Our geological environment and the geotechnical effects of multi-seam working make our roadway support costs high (roof bolting only being practised at the moment as an exception). Our transport system will have to cope with face-to-face distances currently averaging 4km but continuing to increase.

Once the re-equipment of our industry with heavy-duty plant is complete, we have to look for further advances from the increased use of automation. We have already had good experiences from automated power loader vertical guidance and electronic powered support control. The integration of these and other micro-processor based monitoring and control systems is the task now in hand, and we believe we have both the control technology and heavy duty equipment, which are compatible, to make their integration possible.

I have made this brief glance into the future of mining engineering in the UK, because technical change, equipment specification and methods of managing equipment are not mutually exclusive. The systems of asset management we are now developing and establishing in our industry are being put in place to deal with British Coal's short and medium term future, rather than to allow continuation of a system originally put in place to serve another industrial environment at another time.