

FINAL REPORT

**Coordination of Roadway
Development Strategy**

**C5013
February 1997**

ACARP

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DIVISION OF EXPLORATION AND MINING

EXPLORATION AND MINING REPORT

**CO-ORDINATION OF ROADWAY DEVELOPMENT
STRATEGY**

Michael Kelly

**Final Report to ACARP
Project C5013**

February 1997

OPEN REPORT

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1 Executive Summary

This project has developed an agreed industry strategic plan for the improvement of roadway development rates for underground coal mines. It has achieved this through a series of operator meetings where key development issues were discussed, by examining a variety of American practices and via two workshops attended by a broad representation of coal industry personnel.

The plan calls for the introduction of a “systems approach” to minesites assisted by strategies based on the following areas:

- information
- technology implementation
- face downtime/uptime
- project management
- parallel operations
- communication and awareness of a systems approach
- automation

The industry representatives at the workshops concluded:

- 1. It is possible to double existing Roadway Development rates within the next five years, based on existing systems.**
- 2. A systems approach to the problem is mandatory if we wish to achieve this goal.**
- 3. The key to success will be to focus on the interactions of the system and not the component parts, and that the human element of these interactions is pivotal.**
- 4. The technology available today makes doubling Roadway Development rates feasible although the application of technology and how it is implemented can be significantly improved.**

The implementation mechanism is to introduce a systems approach into a small number of “Champion Mines” initially concentrating on the strategies of information, uptime/ downtime and project management. These mines will report back to an industry forum in early 1998. Although envisaged as a five year plan, this approach will allow a stepwise implementation and will keep industry in touch with progress. A longer term view is being taken with automation where there is a need to develop automation priorities.

The implementation of these strategies are being addressed in the current ACARP project **C6037 - Implementation of Roadway Development Strategy.**

2 Introduction

Roadway Development is one of the most important issues facing the profitability, viability and future of underground coal mines. For the last decade roadway development has been unable to keep pace with improvements in longwall extraction rates. In this period, average longwall productivity has doubled whereas roadway development rates have shown little improvement, or in some studies have in fact become worse. With projections of similar improvements in longwall productivity over the next ten years it has been apparent that a concentrated industry effort is required to raise roadway development rates to catch up and match longwall improvements.

As a first step in this process the ACARP Mining Systems Taskforce initiated the Australian Coal Association Underground Roadway Development Workshop in September 1994. One of the major recommendations from the workshop was for the use of a systems or process engineering approach when formulating strategies to address the complex problems facing advances in roadway development. The workshop further concluded that the three principle areas that needed to be addressed were geotechnical and support systems, roadway development systems and outburst control.

Following these recommendations, it was proposed by the ACARP Mining Systems Taskforce to formulate a detailed strategy and business plan for the future direction of Roadway Development Research and specifically to use a systems approach in this formulation. It was envisaged that this approach would result in broader, more sustainable strategies for development improvements. A subsequent study, also supported by ACARP, outlined four different environments that characterise most of the operating Australian longwall mines. Within each environment current roadway development parameters and systems were identified and described. Future targeted performance expectations were also identified. The key part of the study was to identify current systems barriers (and associated research areas) to these targets being achieved.

This project, "Coordination of Roadway Development Strategy" was envisaged to continue this industry initiative to its next stage and develop an agreed industry strategy as suggested in the project title.

3 Objectives

The aim of the project was to facilitate a concentrated industry effort to improve roadway development rates to support current and future longwall extraction technology. The objectives included in the original submission were:

- to encourage the improved understanding and application of a systems approach to improvements in roadway development.
- to liaise with research and manufacturing groups to assist in setting directions for medium and long term machinery and technology development.

- to improve communication opportunities for operators, researchers and manufacturers to discuss both specific and general roadway development needs and improvements.
- to encourage the transfer of research results to actual performance and the transfer of applicable practices between sites both within Australia and from overseas.

It was agreed at the start up meeting that the process to achieve the above objectives was to formulate an informed strategic plan that would be signed off by a broad representation from industry including operators, corporate representatives, manufacturers, maintenance providers, research and high technology providers. The development of the strategic plan would be assisted by a series of operator meetings in key areas and an investigation of the apparently superior American performance levels.

4 Work Program

The work program included:

A series of operator meetings held at minesites based on important development themes. These operator meetings included an underground visit, presentations by usually two guest speakers on the theme, and a general discussion. Because of the minesite visit, numbers were normally limited to 15- 20, and preference was given to mine operators for attendance. The meetings were at:

- Gordonstone, based on development issues in soft roof conditions.
- Newstan, based on place changing
Baal Bone, based on systems approach and
- Tower, based on development issues in a high stress, high gas environment.

Minutes from each meeting were completed and distributed to attendees.

- 2 A CSIRO supported tour of six United States collieries. The mines visited were West Elk, Deer Creek, Plateau, Cumberland, Emerald and Galatia. The Longwall USA conference was also attended and a visit was made to Joy Headquarters as part of this tour. A trip summary from the tour was completed and distributed to previous attendees of the operator meetings as well as intended attendees of the workshops detailed in (4).

Presentations at two conferences on roadway development issues. The papers presented were:

- Kelly, Michael S. 1996. *Roadway Development - Can We Meet The Challenge?* AusIMM Third Underground Coal Mini Symposium. "Productivity improvement towards 2000 The Challenge for Our Industry", August.
- Kelly, Michael S. 1996. *Roadway Development Initiatives in Australian Longwall Mines*. Asia-Pacific Workshop on Coal Mining Technology in Tokyo '96, October.

Travel to the Japanese workshop was supported by the Japan Technical Co-operation Center for Coal Resources Development (JATEC).

4. Two Roadway Development Workshops. The first ran for three and a half days and aimed to establish a strategic industry plan for roadway development. It was attended by a broad cross section of 38 industry representatives. (Appendix One). The second one day workshop prioritised and set an implementation plan for strategies developed in the first workshop. These were published in a draft Roadway Development Business Plan for further comment and discussion.

All of the above documentation has been included in a separate attachment to this report as a record of these activities.

5 Systems Approach

The strategic plan is based on using a “Systems Approach” to roadway development. It is important to summarise what is meant by a systems approach as without this understanding there will be no change from current practices. The first workshop took much of its time discussing the practical application of a systems approach in real situations and was so impressed with its power, made the following conclusions:

It is possible to double existing Roadway Development rates within the next five years, based on existing systems

2. A systems approach to the problem is mandatory if we wish to achieve this goal
3. The key to success will be to focus on the interactions of the system and not the component parts, and that the human element of these interactions is pivotal.
4. The technology available today makes doubling Roadway Development rates feasible although the application of technology and how it is implemented can be significantly improved.

What, then is a systems approach and how is it different from current practice ?

Firstly, a systems approach incorporates people issues and technology into processes. It does not turn a blind eye to the expectations placed upon operators at the face and in essential outbye processes. It says that the **human element is pivotal**.

Secondly, a systems approach aims to understand the complexity of systems structure and to examine the dynamic complexity of the interactions between processes. It does not recognise linear cause and effect relationships in isolation. Instead, it tries to understand the system hierarchies, the dynamic interactions within and between each hierarchy. It further puts the human element in this context and asks who controls and should have input into the various hierarchies. It allows operators in each process to have a primary input in continuous improvement.

Thirdly, a systems approach recognises natural variability as a normal part of any process. It does not react to each new data point but measures variability and establishes longer term strategies to reduce overall variability and improve performance.

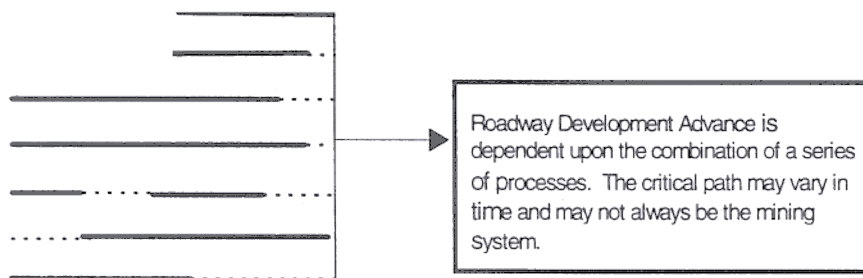
Lastly, a systems approach recognises that the collection and use of information is a key factor. It recognises that information and its analysis is the major business driver that will either improve performance in a long term sustained manner or if used wrongly will result in a short term reactive confusion.

In the workshop two models were used to study the key components and their interactions

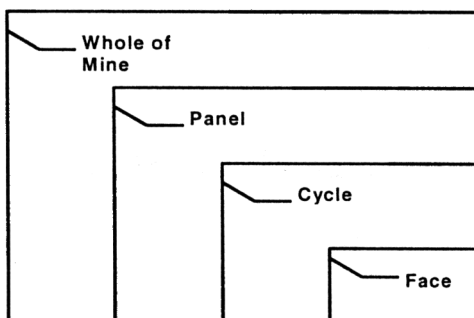
The key components were

1. Mining Systems (cutting, bolting, transporting)
2. Organisational Factors (manning allocation and organisation, measurement systems and motivational factors)
3. Machinery Supply and Support
4. The Human Element (workforce, management, culture, industrial environment)
5. Maintenance Best Practice
6. Systems Support (panel layouts, extensions, gas and water drainage, ventilation, floor control)
7. Strata Support and Gas Control
8. Safety Systems

The two models were a simple form of process mapping (or a simple project management Gantt chart)



- and a simple hierarchy of the various levels that exist at each mine



The key questions to be answered are:

- What is the process map at each level of the hierarchy?
- What is the interaction between hierarchies?
- Who is responsible for the overall process at each hierarchical level?
- For each of these levels what is measured and what is the focus?

6 Strategic Plan

The outcome of the final workshop was a series of seven strategies and implementation mechanisms. The strategies were then prioritised and it was recommended to introduce a systems approach into a small number of “Champion Mines” initially concentrating on the strategies of information, uptime/ downtime and project management. These mines would then report back to an industry forum in early 1998. Although envisaged as a five year plan, the attitude was to take one step at a time and to keep industry in touch with progress. The workshop also concluded that there was a need to set automation priorities for roadway development as automation was a 5-10 year process as evidenced by the example of roof support.

The strategies were in the areas of:

- information
- technology implementation
- face downtime/uptime
- project management
- parallel operations
- communication and awareness of a systems approach
- automation

and are detailed on the following pages

The implementation of these strategies are being addressed in the current ACARP project **C6037 - Implementation of Roadway Development Strategy. (Appendix 2)**

STRATEGY 1 - INFORMATION

The key to this strategy is providing the industry with a comprehensive review of the essential measurement requirements for roadway development. It also aims to assist in identifying current gaps in capabilities to apply and act on these measurements, including the development of an action plan to close these gaps. The basic aim is to determine:

- What is measured, why and what should be measured - including best way to do it.
- What to do with information once it is acquired - Specifications/Standardisation.
Whether technology development is required to achieve the desired measurements.

Scope

Beginning with the management system and keeping the focus solely on roadway development, key scope elements include:

Determine current information requirements, practices and current availability and precision required with respect to:

- **production equipment** eg cutting rates, production time in cycle, motor loads etc.
 - **maintenance monitoring** eg vibration, oil quality, motor performance, component wear indicators, availability.
 - **environmental monitoring** eg ventilation quality, gas, roof, spontaneous combustion alerts.
 - **services** eg belt, ventilation including leakages, water, compressed air, gas drainage, road standards.
 - **other**
2. Define areas of standardisation. This will include:
 - measurement units
 - definitions
 - comparisons (how to make more meaningful between sites)
 3. Recommend areas of development required and initiate where possible.
 4. Guide-lines of areas and mechanisms of feedback to faceworkers, shift supervisors. This should include some model development with feedback loops and signal points.

Implementation Mechanisms

Implementation will be via a focused industry research survey at 8 to 10 selected mines to:

Define Key Result Areas

Identify Key Performance Indicators in use and how acquired

Identify what is currently happening - what do people at face know/need to know/what do management etc know/need to know

The results of the survey will be published in a benchmarking report (preserving confidentiality) and used to drive the agenda of a 2 day industry seminar, entitled:

“Use of measurement in management systems for Longwall Roadway Development”

Outcomes of the seminar will be used to determine current gaps in requirements and further development priorities as well as enable information transfer and possible model development on best practice.

Actions

What	Who	When
Commission survey (use outside resources with ACARP to underwrite and recoup via seminar)	Michael Kelly/ACARP	November 96
Conduct survey	TBA	February 97
Publish report and prepare seminar	Michael Kelly/ACARP	March 97
Conduct seminar	TBA	April 97
Develop information model	TBA	May 97

Comment on ACARP Project C6037

It was decided to incorporate the information, downtime/uptime and project management into one package under this project rather than separate implementation activities for each of these strategies.

STRATEGY 2 - TECHNOLOGY IMPLEMENTATION

This strategy arose through concerns about the gap between the promise of new technology and its delivery. There is not a consistent record of completion of new technology development and many new technologies languish when 80% to 90% complete for lack of a proper technology transfer mechanism.

Scope

It was generally agreed that this is, in part, an ACARP issue. Current practice is that for projects to be funded they must satisfy the cost/benefit hurdle. The main area for improvement is for the researcher/developer to identify “champions” to accelerate implementation ie. identify a viable potential user at start. Key lessons which need to be shared are:

1. Kill lame ducks early
2. Find commercial sponsor/customer early
3. Commercialisation vehicle/customer to work together

While this was generally regarded as an important issue it was felt to be an area that could be best addressed through the ACARP process.

Comment on ACARP Project C6037

This was seen to be a lower priority issue for the first year of implementation and is not being addressed directly in this project.

STRATEGY 3 - FACE DOWNTIME/UPTIME

The objective of this strategy is to apply a systems approach to the analysis of downtime and uptime across the hierarchies of the mine (face, cycle, panel, whole of mine). It is believed that downtime may be reduced by up to 50% using this approach.

Scope

The scope of this strategy is to focus on maintenance and utilisation effectiveness - especially the application of reliability centred maintenance. This in turn depends upon **information** and thus is linked to strategy one. The key questions are:

- How often are you actually cutting coal?
- When cutting, how quickly?

Key elements are

Using a systems approach and looking across hierarchies perform a major industry study in this area (downtime/uptime) - focusing on selected mines (say 5 or 6) who have an interest.

2. Analyse causes of downtime/uptime and associated delays.
3. Make recommendations for improvement

The study should involve a consistent methodology, be done by personnel familiar with operations but external to the mine concerned, looking at details across 24 hr periods in a control period of up to 6 months. It is suggested that the study be syndicated, identifying perhaps 5 or 6 mines to participate at a cost of around \$30,000 each. It will be necessary to preserve mine confidentiality issues, ensuring that information is shared in anonymous form.

Implementation Mechanisms

Implementation should be via an industry syndication with some ACARP support. However execution of the study needs a "champion" - someone with process/industrial engineering background to set up the framework and drive experiments/data collection and work in/with each mine to establish measurements. It must also be someone the industry/syndicate members feel comfortable with:

Possibilities include:

- Terry O'Bierne (ACIRL).
- Engineering master's project (supervised by Michael Kelly)
- Seconded mining engineer from a participating company

Actions

What	Who	When
Develop initial scope	Michael Kelly	November 96
Contact Terry O'Bierne to identify possible people/mechanisms	Michael Kelly	November 96
Invite companies to enter syndicate	Michael Kelly	February 97

Comment on ACARP Project C6037

It was decided to incorporate the information, downtime/uptime and project management into one package under this project rather than separate implementation activities for each of these strategies.

STRATEGY 4 - PROJECT MANAGEMENT

This strategy simply recognises that the application of project management techniques would improve the execution of many underground activities. The desired outcome is a wider experience and application of project management techniques to mining systems. The possibility exists to also consider outsourcing of selected key tasks which may be better project managed by external groups.

Scope

The scope of this strategy is to focus on those underground activities which may be considered as a project. Key elements are:

Identify tasks where project management techniques may be applied.

2. Develop and communicate case study examples
3. Develop guide-lines for management training and tools specifically for underground mines and share via appropriate mechanism (eg seminar)

An assessment would need to be made regarding which non continuous activities, (ie. other than cutting coal, support, maintenance) would be amenable to project management techniques. The obvious activities are: belt extensions, panel installations, panel relocations, longwall relocations (these directly effect face time). Other not so obvious areas are also possibilities: outbye roof support, gas drainage, road preparation, be it either rail installation or trackless road preparation, mains driveage including rock cutting, material handling and others.

Implementation Mechanisms

The suggested implementation mechanism is via an ACIRL seminar "Project Management and its application to roadway development" with case studies to show benefits. This could include specific workshops on project management techniques as they can be applied to roadway development

It is recognised that project management is done today to varying degrees in varying areas by different operators. However, the application is not uniform nor is it focused on a systems approach to improving roadway development rates.

Resources will be required to plan and manage the workshop/seminar - possibly via ACIRL/ACARP as a self funding initiative. Possible implementation steps include:

1. Develop/Research case studies focused on Roadway Development.
2. Run seminar/workshop - with expert assistance.

An experienced project management consultant could be used to help drive this task

Actions

What	Who	When
Contact Consulting Group to outline scope	Michael Kelly	October 96
Consulting Group to identify possible project management consultant	Michael Kelly / Consultants	November 96
Seek ACIRL/ACARP approval when scope defined	Michael Kelly	November 96
Drive collection of case studies for development of seminar/workshops	TBA	March 97
ACIRL/ACARP to target running seminar in new year.	TBA	May 97

Comment on ACARP Project C6037

It was decided to incorporate the information, downtime/uptime and project management into one package under this project rather than separate implementation activities for each of these strategies.

STRATEGY 5 - PARALLEL OPERATIONS

There are numerous areas where the critical path of face operations could be reduced if the capacity was developed to parallel operations. This strategy is to identify opportunities for paralleling operations, to quantify benefits of these opportunities and to further develop this capacity where the benefit is found to be high. Areas of focus could include:

- Face operations eg. cutting and support.
- Cycle operations eg. belt move and cutting.
- Secondary support.
- Resource and needs identification and better techniques for resource allocation.
- Environmental monitoring.

Scope

It was recognised that this strategy is a likely natural flow on from the outcomes of the Face Downtime/Uptime strategy which should reveal which areas to parallel. Manufacturing and technology development priorities should come out of the study if linked to face Downtime/Uptime. There are also links with the information and project management strategies.

Paralleling is already happening in some mines and it would be good for “model” / “champion” mines to progress these initiatives and share learnings.

This strategy should be integrated and addressed as part of the Face Downtime/Uptime study to identify:

- opportunities for paralleling
- constraints
- technology and systems gaps

It is desirable that the study encourage writing up of successful case examples.

Comment on ACARP Project C6037

This was viewed as a downstream activity for the uptime/downtime study and no specific activity is been undertaken in the C6037. There should however be conclusions that will directly benefit this strategy.

STRATEGY 6 - COMMUNICATION AND AWARENESS OF A SYSTEMS APPROACH *(previously human factors/organisational structure)*

It was recognised that this is a key area for action but that, with the current thrust in the industry toward enterprise management, the best a forum such as this can hope to do is to provide frameworks or structure for companies to consider - each enterprise must implement a systems approach, particularly as it applies to human factors and organisational structure, in a way which best suits its own needs.

The strategy here is to increase communication and awareness on the issue, demonstrating the high leverage that can be obtained, and demonstrating to statutory authorities that the control loops provided by the method exceed prescriptive guidelines.

Scope

Possible elements of the scope here include:

- Presentations to industry forums
- Education/ awareness raising within industry groups.
- Session/Seminars on this approach → apply systems approach/system thinking.
- Write papers/articles/newsletters.
- Highlight leverages/ benefits to be gained
- Training/ education on a systems approach.
- Concentrate on role of middle management
- Focus on student groups.
- Build into ACARP processes.

Because this is a sensitive area to most companies, education and facilitation will be the keys for success.

The main focus is to build into company cultures adoption of a systems approach, recognising that human factors and organisational structures are an integral part and cannot be quarantined from causal relationships. How companies deal with that information will always be their prerogative.

Implementation Mechanisms

This is an area that requires a very broad based implementation scheme. Universities have an important part to play. There should be speakers at most mining conferences and seminars to demonstrate practical examples and advantages of this approach. The utilisation of the champion/model mines will be important. ACARP's role is important as it needs to be built into ACARP processes and proposals. Training of middle management groups are the key for success and training packages need to be addressed, perhaps in the marketplace by consultant management groups. Involvement of worker groups is also important to give/pass information on relative

areas, for ergonomic issues and generally to recognise their key role in determining what face processes are likely to work, ie nuts and bolts issues.

Actions

What	Who	When
Prepare a paper based on distillation of these workshops plus case studies.	Michael Kelly	January 97
Introduce "seed" talks in seminars.	Michael Kelly	Ongoing
Continue workshops at key mines as follow up to this workshop, emphasising systems approach.	Michael Kelly	Ongoing
Discuss Course Structure with University Mining Schools and other Mining Colleges.	Michael Kelly	Ongoing
Encourage system courses suitable for middle management	Michael Kelly	Ongoing

Comment on ACARP Project C6037

This is an underlying foundation of the project and will be addressed at the study mines by an initial forum, ongoing discussion and final workshop. It is also being addressed through several formal presentations throughout the year and through the seminar in 1998.

STRATEGY 7 - AUTOMATION

This is seen to be a long term activity where effective automation should be based on effective information systems and identification of where the bottle-necks exist which are amenable to mechanisation/automation. The focus should be on key areas (eg. roof bolting) where the industry has some maturity in approach and other areas where it is a long way from where it needs to be.

Scope

Automation has a tremendous potential to improve safety, consistency and productivity but has historically been associated with issues of over complication and poor implementation performance. Priorities should be established through cost benefit analyses to decide the scope of automation to provide the optimum result.

Key elements of the scope of this strategy include:

- 1 What is the vision/goal for automation?
- 2 What is the technology roadmap to get there?
- 3 Define the four stages - manual, mechanised, remote, automation
- 4 Where are we now and where do we want to be/priorities - (some manual → some automated).

As a first step there is a need to do a scoping study to identify needs/priorities and initiate projects eg. face to bootend (shuttle cars).

Implementation Mechanisms

There are already groups set up eg. CMTE, David Dekker's Mining Automation group that are focusing on automation technology. The implementation mechanism needs to revolve more around linking manufacturers, technology groups and operators into looking at specific needs, responses and underground implementation.

It is proposed that CMTE carry out the scoping study defined above with the help of an industry steering panel and linked with the Uptime/Downtime study with funding to be CMTE 50% - ACARP 50%.

Comment on ACARP Project C6037

A recent paper ⁽¹⁾ has outlined this prioritisation process and an out of round proposal to carry out the above study will be submitted in April 1997.

⁽¹⁾ Kelly, Michael S., 1997., "*The End of the Line for Roadway Development*", AusIMM Travelling Technology Forum., Automation in Coal Mining., March.

Appendix 1 - List of Workshop Participants

NAME	COMPANY
Allan, Bruce	BHPAC Collieries Division, Wollongong, NSW
Butcher, Bob	Powercoal Pty Ltd, Charlestown, NSW
Cribb, Ian	Cumnock No.1 Colliery, Ravensworth, NSW
Cuddihy, Paul	White Mining, Mackay, QLD
Davies, Alan	BHPAC, Brisbane, QLD
Downs, Michael	BHPAC, Brisbane, QLD
Doyle, Peter	Cyprus Australian Coal, Lithgow, NSW
Eade, Philip	BHPAC Collieries Division, Wollongong, NSW
Edgar, John	Monitek, Brisbane, QLD
Fabjanczyk, Mike	Strata Control Technologies, Wollongong, NSW
Gooley, Ray	Jeffrey Mining Products, Toronto, NSW
Graham, Ross	Australian Coal Association, Sydney South, NSW
Hamilton, Neville	Oceanic Coal Australia Ltd, Teralba, NSW
Hebblewhite, Bruce	University of New South Wales, Sydney, NSW
Hines, Chris	Boart Longyear Pty Ltd (Mitsui Miike), Cardiff, NSW
Hobson, Tim	South Blackwater Coal Ltd, Blackwater, QLD
Howarth, Dominic	JKMRC, Indooroopilly, QLD
Lilly, Peter	CSIRO, Exploration & Mining, Floreat Park, WA
Marsden, Garry	Tamrock Coal Australia Pty Ltd, Gateshead, NSW
McCowan, Brian	ACIRL, Maitland, NSW
Melrose, Rowan	Voest Alpine, Wetherill Park, NSW
Morrall, Bryn	South Blackwater Coal Ltd, Blackwater, QLD
Moult, David	Joy Mining Machinery, Pittsburgh, PA
Neal, Phil	Joy Mining Machinery, Mossvale, NSW
Neilson, Brad	CRAM Australia, Unanderra, NSW
O'Rielly, Tony	White Mining, Mackay, QLD
Oliver, Dave	Newstan Colliery, Toronto, NSW
Ord, Steve	Long Airdox Australia Pty Ltd, Argenton, NSW
Ostle, Stan	ANI Arnall, Charlestown, NSW
Pomfret, Dennis	Powercoal, Charlestown, NSW
Robertson, Bruce	Shell Coal Australia, Brisbane, QLD
Sandford, Jim	Capricorn Coal Management, Middlemount, QLD
Sleeman, Jon	U/G Coal Mining Consultancy, Holland Park, QLD
Takahashi, Ken	Coal Mining Research Centre of Japan, Tokyo
Weatherstone, Col	BHPAC Collieries Division, Wollongong, NSW
Williams, Ray	Geogas, Oak Flats, NSW
Wischusen, Roger	AMIRA, Brisbane, QLD
Wood, Murray	Gordonstone Mine, Emerald, QLD

Appendix 2

Proposal ACARP Project: C6037

Implementation of Roadway Development Strategy

1. Preamble

ACARP and CSIRO supported an initiative through 1996 that facilitated industry wide discussion on the principal issues facing roadway development (RWD), and formulated an agreed industry plan that when implemented will potentially double industry development rates over the next five years. The use of a systems approach to roadway development has been the basis of the discussions and plan development. Within this approach roadway development is recognised as a complex series of processes and hierarchies in which the interactions are complex, often invisible and are time dependent. A systems approach recognises the complexity of the system and manages it as a whole rather than as individual processes. In a systems approach the result is not equal to the sum of its parts, it is the outcome of the *interaction* of the parts.

The strategies during the two workshops last year included:

- information - requirements, practices, capabilities and precision
- technology implementation - commercial sponsors, reviews, partnerships
- face downtime/uptime- underlying systems reasons for downtime, improvement and consistency of uptime rates
- project management - identify tasks where applicable, case study examples
- parallel operations - the use of systems and new technology to reduce the critical path of face activities
- implementation of a systems approach - through presentations, industry discussions, education/awareness, middle management role
- automation - setting long term priorities, technology roadmaps, initiating technology development.

The final workshop prioritised the strategies and recommended that the work on information, face downtime/uptime and project management should be tackled first with an initial study on the automation priorities.

2. Implementation Strategy

This proposal is part of the current ACARP project C6037 "Implementation of Roadway Development Strategy". The project encompasses the following activities:

- Identifying four to six longwall mines in Australia who wish to introduce or improve (or champion) a systems approach to roadway development with the assistance of this project. These will be referred to as "Champion Mines".
- Identifying suitable consultant groups to assist in this implementation, specifically in the areas of information, face downtime/uptime and project management.
- Formulating a joint proposal from the consultant groups and CSIRO (referred to as the Project Team) to assist the Champion Mines in the implementation of a systems approach. **(ie this proposal)**
- Securing agreement with the Champion Mines on proposal details including site commitments, interaction, reporting, confidentiality and costs.
- Carrying out the work program at the Champion Mines from April 1997 to March 1998.
- Organising the seminar to feed back outcomes from Champion Mines to industry in April - May 1998.

3. Site Commitment

This work is to assist the sites introduce or improve a systems approach to roadway development and not to implement it for them. As such, there is a substantial amount of work and development that the sites will need to undertake to make such an implementation or improvement tangible, transformative and longlasting. It is recognised that this is a core business activity for all mines and that there may already be substantial activity at the mine, and corporately, for roadway development improvement. The key to the success of this work is that it must be fully integrated with the existing improvement effort so that they are the one activity, otherwise they will simply undermine each others efforts and have a net negative impact.

The commitment from the mine will need to include:

- a desire to improve roadway development performance by the implementation of a systems approach to the problem.
- acceptance that this will involve a change process.
- recognition that the process must involve faceworker and middle management as well as senior management support.
- understanding that the process may involve a major change in the way information is collected and used.

To facilitate this process a temporary development improvement team needs to be initiated at the mine. This team would be responsible for guiding the change process and liaising directly with mine workers and our project team. It may consist for instance of a development coordinator, engineer/tradesman for maintenance advice, deputy or other statutory official for statutory and practical organisational issues and a miner for liaison with face workers and detailed practical issues. The team would not be permanent and only work as required.

4. Work Program.

4.1 Scope

a) Definition of Systems Approach and site application

- Define specific site program at each mine.
- With the liaison team and others at the mine, conduct a forum on the introduction of a systems approach.
- Coordinate activities of project Team.
- Regular followup at each mine on systems approach issues.
- Final report and presentation at each mine.

This will be conducted by Michael Kelly, CSIRO.

b) Information Study

- Analyse what information is available, its accuracy and usefulness in quantifying RWD.
- Investigate what feedback loops to the staff and workforce exist and what may further assist RWD.
- Investigate improvement needs (including technology improvement needs).
- The role of information as a business driver for RWD.
- Final presentations to site staff.

This will be conducted by Dr. Mark Harrigon, formerly of Invetech assisted by Michael Kelly.

c) Investigation of face downtime / uptime

- An appraisal of the roadway development cycles including a benchmark of current cycle times and expectations. Emphasis will be placed on the hierarchy of cycles (face, pillar, panel, whole of mine) and the interaction between these cycles.
- Establishment of communication requirements between the mine and the consultant to continue this study on a weekly timetable over a baseline of 6 months.
- Ongoing analyses of cycle interactions and areas of improvement.
- Investigation of uptime rates with emphasis on the instantaneous maximum, and determining 1) how this may be improved and 2) its relationship to average uptime rates.
- Comparisons between minesites used in the study where appropriate.
- Follow up sessions at each mine after 1 and 4 months.
- Final presentations to site staff.

This will be conducted by Mr Stephen Eames from Dames and Moore with some assistance from Michael Kelly during the first appraisal.

d) Project management techniques

- Identifying and prioritising key non-continuous activities associated with RWD where project management techniques may be applied
- Selection of a critical activity for a case study.
- Developing a standard management plan for the activity with appropriate timing, resources and performance measures.
- Implementation of management plan with selected activity.
- Review and revision of plan and review other applicable activities.

This will be conducted by Bob Miller from Hawcroft Miller Systems Management assisted by a project engineer from Thomas Crowe Project Management.

e) Close out activity

At the end of the six month baseline, there will be a workshop between the project team, the mine liaison team and other interested persons at the mine. The aim of the workshop is to review the progress of the project during the six months and to set the ongoing agenda and action items for the mine that will achieve a significant improvement in roadway development. This is described as the mine presentations in the previous sections. It would be expected that the mine would take part in the report back seminar to industry to be held in April - May 1998.

Timing

The typical timing is shown on the attached Gantt chart. (Attachment A) Please note that up to six mines will take part in the study so that timing will vary from mine to mine. Mines will start the project progressively from April through to June, and complete from December through to March.

Champion Mine Cost

Only the direct cost from the additional consultants will be charged to the mine. These costs are shown in the following spreadsheet. The total cost to each Champion Mine is \$47,600. Of this total the consultant time component of \$36,900 is fixed, whereas the consultant travel / office costs of \$10,700 are an estimate. The project is further supported by \$125,000 from ACARP and \$65,000 from CSIRO. These funds will support all of Michael Kelly's travel and time costs as well as the seminar and other project activities.