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The Success of Fly-in Fly-out Australian Mining Operations

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ABSTRACT

Australia's mineral resources boom in the two decades up to 1980 saw the establishment of about 25 new mining towns across the continent. Quality housing and a high standard of community services were incorporated to attract a labour force for the major mine or mines being serviced. Town construction costs were high and were principally born by the private enterprise mine developer.

There has been a change in the pattern in recent years and over 20 new mine developers have adopted a fly-in fly-out arrangement rather than construct new towns. Employees are drawn from a home base which is typically a large city, coastal community or established mining town and flown to the mine site for intensive work periods of about two weeks. The change has occurred for many reasons. Mining companies have been unwilling to support the high construction costs of towns, short life and smaller mining operations do not justify a town, fast jet aircraft are available and there is a better perceived family lifestyle in established (coastal) communities. On the other hand reduced permanent development at new mine sites does not assist Australia's perceived need for decentralization. There have been questions as to the social problems which may develop from the artificial separation of the "breadwinner" from his family.

The paper reviews a recent survey of the attitude of Australian mining companies employees, governments and unions to fly-in fly-out arrangements. The support for this approach is analysed and conclusions drawn that the concept is likely to be with the Australian mining industry for some time in the future.

INTRODUCTION

Australia experienced major mining industry expansion in sectors such as iron ore, bauxite, coal, beach sands and base metals in the two decades up to 1980. It was a time when big tonnage mines with long projected lives were built for a growing export market. Major mines developed in isolated areas incorporated a new modern town. About 25 new mining towns were built across the continent with quality housing and a high standard of community services.

This approach to servicing mine development involved high town construction costs. These were principally borne by the private enterprise mine developer although state and local governments normally provided some community services. Those that serviced one mine lacked a diversified economic base and often were seen as "company towns". Social problems which have been highlighted included lack of employment for wives, poor educational facilities and high cost of living.

There has been a change in the pattern in recent years and over 20 new remote Australian mine developers have adopted a Fly-In Fly-Out (FIFO) arrangement rather than construct new towns. Employees are drawn from a home base which is typically a large city, coastal community or established large mining town and flown to the mine site for intensive work periods of about 7 to 14 days. Many reasons, no doubt, have contributed to the change. The high construction cost of "single industry" towns, fringe benefits taxation, small scale and life span of many operations (particularly gold), availability of fast jet aircraft and the better perceived family lifestyle in established (coastal) communities have been given as reasons for the different approach. On the other hand, reduced permanent development at new mine sites does not assist Australia's perceived need for decentralisation. There have been questions as to the social problems which may develop from the artificial separation of the breadwinner from his family.

The change to the operation of mining ventures has been significant. Some mines are producing which would have been uneconomic if the construction of a town had been required. A study was needed to examine the impact of the change. A survey was undertaken on the effects of the change on mining operations, personnel and other relevant bodies. This paper examines the FIFO concept and reports on a study into its recent impact on Australian mining.

BACKGROUND

FIFO has become common practice in the Canadian mining industry during the last two decades. Its introduction has been explained by a decline in popularity of resource towns, changing work force attitudes, changes in government policies and technological advances in the mining industry (Story and Shrimpton 1988). Similarities between Canada and Australia are obvious in respect of population distribution and the location of mining operations in remote areas with inhospitable climatic conditions.

Many Canadian operations are located in the northern half of some of the western and central provinces and are thus remote from any major population centre. The early experience in Canada was that mining provided the major impetus in the development of remote regions. As social and community expectation increased, with pursuit of higher wages, job and social security entitlement, material conveniences and improved quality of life. Since World War II, support for development of remote mine sites and their communities has been found an increasing burden for mining companies. In addition has been the problem of social dislocation caused by closure of operations upon which depended some of the earlier and longer established mining communities (Letts et al 1989). The FIFO approach originated in the Soviet Union in the 1960s for their remote mineral deposits and the international offshore oil and gas industry. The first Canadian FIFO operation adopted for a mining venture was carried out by a mining company with experience of this system in offshore oil. The project began in the early 1970s and was regarded as a successful operation (Nogas, 1976). Since then, the FIFO system in conjunction with Compressed Work Schedules (CWS) has become common practice in setting up mining operations in remote areas of Canada.

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In Australia not many orebodies are found on the scale of Broken Hill, Mount Isa or Mount Lyell which can sustain a century of operations and thus warrant establishment of substantial townships or small cities. Even for orebodies on this scale, the end must come and the social dislocation caused by closure of mining towns is profound. In a series of studies of northern mining towns in Australia, the exogenous and endogenous reasons for moving to and staying in a remote mining town such as in the Pilbara have been examined by the Resource Communities Environmental Unit (Bresley, Neil and Jones, 1983; Neil, Jones, Bresley and Newton, 1984.) Economic reasons appear to be important motivators for moving to the Pilbara while reasons for staying appear to be more personal and complex. Problems caused by alcohol, job opportunities for children and friendliness in the town have often determined length of stay (Syme et al, 1986).

Most orebodies found in Australia have a fairly limited life, ranging from 4 or 5 years to at most 20 to 30 years. The reality of this limitation, associated with the high cost of infrastructure in remote areas and the cyclical vagaries of international metal prices, necessitates against the establishment of any substantial residential communities for these operations. Therefore, it was logical to expect the development of a community system for the workforce, based on provision of "temporary" accommodation on site for employees. The short life Nabarlek uranium operation and Argyle diamond project were the first two major mining operations to implement a FIFO system in Australia. The Argyle Diamond Mine utilises a two week out cycle, with 12 hour shifts. FIFO has since been adopted by a considerable number of the more remote open cut gold mines operating on various combinations of FIFO and CWS systems. These gold mine projects generally exhibit a small ore body, short expected mine life, low cutoff grade and remote location.

A further disincentive to establishment of townships with subsidised low rental housing in remote areas has been the introduction of fringe benefit taxation as a cost to the employer or mine operator. While the mining industry has wrestled with the problems of providing satisfactory living conditions for its workers in remote areas, it is by no means a purely philanthropic concern since the costs of hiring, training and settling in replacements for workers who leave the industry as a result of dissatisfaction with living conditions are a major economic burden to the companies.

Jackson (1987) pointed out that commuter mining has a positive impact on most of the distinctive characteristics of the mining industry which severely constrain its activities. Table 1 shows some characteristics of mining industry and the impact of FIFO. Some characteristics of remote mining communities also have been improved through the use of FIFO. These improvements were identified as follows:

1. Family lives of workers have been greatly improved.
2. Environment impact and the cost of impact studies are reduced.
3. Existing communities are not undermined by the removal to mining towns of part of their workforce.
4. Government expenditures on health, education and social services are handled more efficiently.
5. With reduced costs both profits to the company and taxes to government are increased.
6. The problems caused by the closure of mining towns.

From company viewpoint it appears that there is less difficulty in attracting workers and retaining them (Nagas, 1976), Storey and Shrimpton, 1988). Turnover rates at the Kidston Mine, Queensland, have been under five percent per year, compared to 50 to 100 percent in many other mining communities (Jackson, 1987). Research into commuter mining in the mining industry and offshore oil industry (Jackson, 1987, Storey and Shrimpton, 1988) shows many employees appreciate being able to live in their home communities while retaining family and friendship ties and taking advantage of facilities and opportunities that are not available in remote communities.

Table 1 Characteristics of mining industry and some impacts of commuting (after Jackson, 1987)

Mining industry characteristic	Impact of FIFO
1. High and increasing capital cost	Reduces capital cost by transferring cost of town to recurrent cost covering fly-in fly-out operations
2. High risk and need for flexibility in view of rapid price fluctuations	By reducing capital costs. Fly-in fly-out reduces risk and adds flexibility
3. Insufficient existing infrastructure in project area (eg health & education facilities, road, power supply	Reduces need for infrastructure in some cases to nil
4. Insufficient land availability	Reduces land demand and environmental impacts
5. Inadequately skilled local labour force	Allows use of existing skills in other areas without relocation
6. Long payback period on investment loans	By decreasing capital costs, shortens payback period
7. Political risks	By reducing risk capital, lessens effects of political risks

THE SURVEY

Groups Surveyed

To ascertain the importance of FIFO to Australian mining, four groups were surveyed by letter and questionnaire, namely mining operators, mining employees, government departments of mines and Unions servicing the mining industry. The approach to the survey was as follows.

Mining Operators

Over 100 operations were approached to complete the survey form. All known FIFO mining operations were included (19 in total). Other mines targeted were selected on the basis of being of significant size and located away from settled areas. The majority surveyed were metalliferous mines. Names and addresses were taken from a list of Australian non-coal mines producing more than 150,000 of ore per year (Anon, 1989). Queensland Bowen Basin coal mines were included. Other coal mines were considered to be too close to settled areas. Fifty-six operations responded to the survey, including 18 FIFO operations.

Mining Employees

The survey package to known FIFO mining operations included additional one page employee questionnaires. Mining companies were asked to distribute these to individuals for response and then return them with their company response. All but one of the FIFO operations responding returned these individual response sheets.

Mines Departments

Mines Departments in all states and the Northern Territory were approached and all responded.

Unions

To gain a response from employee unions, Queensland representatives of five unions servicing the mining industry were approached. Two responded.

Survey Questionnaire

A six page questionnaire was mailed to known FIFO operations and those served by traditional towns. In brief, the following information was sought.

1. Operating details including products, output, mining and processing methods, reserves and workforce number by classification.
2. Employee accommodation information including distance to nearby towns, provision of single person quarters and use of commuting buses to mine site.
3. For FIFO operations, details on travel arrangements, work schedule and mine camp facilities. Questions were asked on the influence of FIFO on mine profitability, employee motivation and retention, social and family problems, and the positive recreational advantages to employees.
4. For operations using a traditional town questions were asked on travel arrangements and the basis for existence of the town. Information was sought on the influence of township infrastructure arrangements on mine profitability, employee motivation and retention, social and family problems, and the positive recreational advantages to families.
5. A final section on the reaction of governments and financiers to FIFO and opinions on the future of the concept.

The one page employee questionnaire asked background questions on family situation, nature of work and work schedule. This was followed by a series of questions where the respondent was asked to indicate his views on a numeric scale from 10 for "Completely agree" to 1 for "Completely disagree". The questions were as follows.

1. I selected this job because I personally like the fly-in fly-out arrangement.
2. I selected this job because my family like the fly-in fly-out arrangement.
3. My immediate family relationships have been seriously disadvantaged by fly-in fly-out arrangements.
4. I like the fly-in fly-out arrangement because it gives me time for a second job.
5. I like the fly-in fly-out arrangement because it gives me time for hobbies and recreational activities.
6. I find that fly-in fly-out arrangements are a major personal interference to community activities such as Church, education and sport.
7. I find that fly-in fly-out arrangements are a major family interference to community activities such as Church, education and sport.
8. If I change jobs, I would actively seek another fly-in fly out arrangement.
9. If I change jobs my family would fully support me in seeking out employment at another fly-in fly-out operation.

State Mines Departments and Unions were asked to respond to the following series of questions.

1. Attitudes to fly-in fly-out mining operations in your state (if any) as opposed to the construction of a traditional mining town concept.
2. Attitudes to future developments of this type.
3. Would your government be prepared to cover a greater share of the cost of constructing traditional mining towns.
4. What problems now and in the future are seen if more fly-in fly-out operations are developed.

Throughout the survey, it was emphasised that confidentiality of all respondents would be maintained.

SURVEY RESULTS

Fifty six operations responded to the survey. A breakdown of responses indicated the following.

1. 38 operations were serviced by a traditional town and 18 were FIFO (the term FIFO has been used to include one response from a Drive-in, Drive-out operation.)
2. 25 operations were gold or gold, copper, silver mines.
3. 35 operations were open cut, 12 were underground and 9 used both mining methods.
4. 36 operations were established since January 1st, 1983. all 18 FIFO were included within this category.

Table 2 summarises responses from the 18 FIFO mines. The individual responses indicate mine product, underground or open cut, annual production, expected mine life in years, and probability of an extension of this mine life. The table includes information on when production commenced, present employment and a breakdown of this number to professional, award and other categories. It indicates the distance to the nearest town and this towns economic basis for existence. The percentage of the workforce living in the three most important servicing towns and the existence of a Camp Single Persons Quarters.

Table 3 summarises survey responses from the 38 non FIFO mines using the same approach.

Table 4 examines the results of the individual employee survey on personal attitudes which were returned from 17 mines. The 161 responses were analysed by mine and then aggregated. The table also indicates average responses to each question by employment category, marital status and length of work schedule.

Government Departments of Mines in New South Wales, Victoria, South Australia and Tasmania responded to the survey by indicating no present FIFO operation within their borders. The responses from Western Australia, Queensland and the Northern Territory can be examined by question:

1. Present attitudes to FIFO. The replies indicated that individual assessment was made of the merits of each case. Important issues are the mine life and workforce size, proximity to existing towns, wishes of local Aboriginal communities and infrastructure costs of community services. One response underlined that the "traditional mining town concept" is dead and new towns should be "open" and multi-use centres for a region.
2. Attitudes to future FIFO. all responses indicated that the present attitude will continue into the future.
3. Government contribution to the construction cost of mining towns. There was agreement that there must be a substantial community and regional cost benefit to government investment in mining town facilities. Government contribution would be looked on favourably where a mine has a long projected life (greater than 10 to 20 years) and a new town could form the nucleus of regional development.
4. Perceived problems now and in the future with FIFO. General agreement that governments encourage mine development and appropriate FIFO approaches was clear. However reservations were indicated that FIFO detracts from the development of regional centres to an economic size. The economic benefits and costs of decentralisation policies are difficult to quantify. Economics and social costs of obsolete infrastructure and the

Table 2. Summary of Survey Responses from FIFO Mines.

OPERATION			ANNUAL	EXPECTED	PROBABILITY	YEAR	EMPLOYEE	WORKFORCE DISTRIBUTION (%)			CLOSEST TOWN		RESIDING TOWNS KM(%)			S.P.Q.	TRANSPORT
NAME	PRODUCT	TYPE	PRODUCT	MINE LIFE	EXTEN. LIFE	START	NO.(1990)	PROFESS.	AWARD	OTHER	KM	FUNCTION	TOWN A	TOWN B	TOWN C	UTILITY	
A	GOLD	BOTH	50000 OZ	6	HIGH	1968	43	33	67	0	130	FARMING	490(75%)	300(5%)	N/A	YES(1)	PLANE
B	ZINC	U/G	125000 T	5	HIGH	1968	140	9	63	28	80	CATTTLE	80(8%)	500(70%)	520(22%)	YES(1)	PLANE
C	GOLD	BOTH	550000 OZ	4	HIGH	1987	80	19	68	13	8	CATTLE	8(30%)	600(60%)	500(10%)	YES(1)	PLANE
D	GOLD	O/C	48000 OZ	3	HIGH	1969	85	10	80	10	110	MINING	N/A	N/A	N/A	YES(1)	PLANE
E	GOLD	O/C	45000 OZ	6	VERY HIGH	1989	40	37	63	0	170	SERVICE	1000(95%)	N/A	N/A	YES(1)	PLANE
F	GOLD	O/C	60000 OZ	1	HIGH	1987	100	13	80	7	90	N/A	800(97%)	1100(1%)	900(2%)	YES(1)	PLANE
G	GOLD,CU	O/C	N/A OZ	4	POSSIBLE	1963	160	10	85	10	150	N/A	800(99%)	N/A	N/A	YES(1)	PLANE
H	GOLD	O/C	32000 OZ	2.5	HIGH	1987	65	9	48	43	110	MINING	110(12%)	N/A	N/A	YES(1)	BUS
I	GOLD	O/C	200000 OZ	7	POSSIBLE	1985	271	29	71	0	300	N/A	400(60%)	300(40%)	N/A	YES(1)	PLANE
J	GOLD	O/C	60000 OZ	3	VERY HIGH	1989	50	5	40	45	20	FARMING	1000(99%)	N/A	N/A	YES(1)	PLANE
K	DIAMOND	O/C	750000 CT	6	HIGH	1988	105	6	79	15	200	CATTTLE	3500(70%)	900(25%)	200(5%)	YES(1)	PLANE
L	GOLD,CU	O/C	N/A	9	POSSIBLE	1986	172	19	66	27	17	CATTTLE	17(5%)	150(55%)	200(40%)	YES(1)	PLANE
M	GOLD	O/C	31835 OZ	5	HIGH	1984	110	10	90	0	50	MINING	N/A	N/A	N/A	YES(1)	PLANE
N	GOLD,CU	BOTH	88200 OZ	4	HIGH	1988	172	12	18	70	150	CATTTLE	150(23%)	260(14%)	1000(63%)	YES(1)	PLANE
O	GOLD	O/C	60000 OZ	4	VERY HIGH	1987	70	2	88	10	400	CATTTLE	800(100%)	N/A	N/A	YES(1)	PLANE
P	GOLD	O/C	72000 OZ	7	HIGH	1988	84	13	77	10	23	MINING	23(4%)	N/A	N/A	YES(1)	PLANE
Q	GOLD	O/C	N/A OZ	7	POSSIBLE	1984	170	10	85	10	6	N/A	700(99%)	N/A	N/A	YES(1)	PLANE
R	GOLD	O/C	N/A OZ	6	POSSIBLE	1985	154	21	64	15	15	CATTTLE	15(7%)	180(55%)	240(38%)	YES(1)	PLANE

Table 3. Summary of Survey Responses from Non-FIFO Mines.

OPERATION			ANNUAL	EXPECTED	PROBABILITY	YEAR	EMPLOYEE	WORKFORCE DISTRIBUTION (%)			CLOSEST TOWN		RESIDING TOWNS KM(%)			S.P.Q.	TRANSPORT
NAME	PRODUCT	TYPE	PRODUCTION	MINE LIFE	EXTEN. LIFE	START	NO.(1990)	PROFESS.	AWARD	OTHER	KM	FUNCTION	TOWN A	TOWN B	TOWN C	UTILITY	
A	GOLD	U/G	80000 OZ	3	HIGH	1986	200	18	72	7	40	MINING	40(2%)	N/A	N/A	YES(1)	PRIVATE
B	COAL	O/P	8000000 T	25	LOW	1984	355	6	90	4	26	AG, CATTLE	26(100%)	N/A	N/A	YES(2)	PRIVATE
C	BAUXITE	O/C	405000000 T	60	POSSIBLE	1983	85	20	70	10	15	AG,TIMBER	130(6%)	80(4%)	75(4%)	NO	PRIVATE
D	BAUXITE	O/C	10000000 T	30	HIGH	1962	1200	20	80	0	8	N/A	8(100%)	N/A	N/A	YES(2)	COMP.BUS
E	ZINC,LEAD	U/G	120000 T	21	VERY HIGH	1982	300	8	73	19	49	RURAL	49(98%)	N/A	N/A	YES(2)	COMP. BUS
F	COAL	O/C	4000000 T	50	HIGH	1957	399	5	95	0	30	FARMING	30(40%)	33(40%)	60(10%)	NO	PRIVATE
G	GOLD	U/G	N/A	5	LOW	1970	300	10	80	10	50	PASTROL	50(20%)	N/A	N/A	YES(1,2)	COMP. BUS
H	TIN,TA	O/C	2100000 T	2	HIGH	1964	160	11	73	16	2	N/A	2(48%)	15(50%)	50(2%)	YES(2)	PRIVATE
I	NICKEL	O/C	107000000 T	N/A	N/A	1974	160	16	80	4	10	N/A	10(100%)	N/A	N/A	YES(2)	COMP. BUS
J	GOLD	O/C	150000 OZ	5	LOW	1988	88	7	93	0	26	FARMING	26(15%)	31(15%)	83(20%)	YES(2)	PRIVATE
K	TUNGSTEN	BOTH	120000 T	10	HIGH	1917	90	12	74	14	2	N/A	2(89%)	30(7%)	23(4%)	NO	PRIVATE
L	GOLD	BOTH	100000 OZ	4	HIGH	1976	112	18	82	0	4	FARMING	4(80%)	35(20%)	N/A	YES(2)	COMP. BUS
M	CU,PB,ZN	U/G	500000 T	50	HIGH	1924	5018	20	80	0	1	N/A	N/A	N/A	N/A	YES(1)	PRIVATE
N	GOLD,SILV	O/C	11500 OZ	0.25	N/A	1989	50	20	80	0	5	MIN,TIM	75(1%)	55(1%)	N/A	NO	PRIVATE
O	GOLD	O/C	3000000 T	10	HIGH	1986	225	15	75	10	30	GZ,BEEF	30(100%)	N/A	N/A	NO	PRIVATE
P	BAUXITE	O/C	2500000 T	50	VERY HIGH	1981	848	31	59	10	10	N/A	10(100%)	N/A	N/A	YES(2)	PRIVATE
Q	COAL	O/C	4500000 T	15	HIGH	1983	460	5	82	13	32	N/A	32(100%)	N/A	N/A	YES(2)	PRIVATE
R	GOLD	O/C	60000 OZ	4	HIGH	1987	69	14	63	23	73	PASTROL	23(100%)	N/A	N/A	NO	PRIVATE
S	GOLD	O/C	60000 OZ	5	POSSIBLE	1986	97	10	80	10	15	RURAL	15(86%)	75(4%)	100(10%)	NO	PRIVATE
T	ZINC,LEAD	U/G	2500000 T	15	HIGH	1907	1500	12	60	28	2	N/A	2(100%)	N/A	N/A	YES(2)	PRIVATE
U	GOLD	O/C	1500000 T	5	HIGH	1985	150	25	40	35	1	MINING	230(1%)	90(4%)	N/A	YES(2)	PRIVATE

Table 3. (continued).

V	TUNGSTEN	O/C	1000 T	8	HIGH	1971	3	20	80	0	1	N/A	30(5%)	1(10%)	N/A	YES(1)	PRIVATE
W	TIN	U/G	8500 T	10	POSSIBLE	1964	430	17	69	14	15	MINING	15(90%)	15(5%)	45(5%)	YES(2)	COMP. BUS
X	IRON	O/C	22000000 T	25	HIGH	1972	320	5	75	20	10	N/A	N/A	N/A	N/A	YES(2)	PRIVATE
Y	ZINC,LEAD	U/G	520000 T	15	HIGH	1935	475	10	75	15	0	N/A	0(100%)	N/A	N/A	YES(1,2)	PRIVATE
Z	IRON	O/C	2400000 T	5	VERY HIGH	1967	323	4	79	17	2	N/A	2(100%)	N/A	N/A	YES(1)	PRIVATE
A1	GOLD	O/C	35000 OZ	2	HIGH	1987	47	32	68	0	5	FARMING	5(100%)	N/A	N/A	YES(2)	PRIVATE
B1	GOLD	U/G	47000 OZ	6	HIGH	1981	122	13	62	25	2	FARMING	2(90%)	N/A	N/A	NO	PRIVATE
C1	GOLD	BOTH	275000 OZ	10	VERY HIGH	1977	360	11	72	17	2	N/A	2(100%)	N/A	N/A	YES(2)	COMP. BUS
D1	ZINC,CU	BOTH	150000 T	10	HIGH	1989	150	20	33	47	70	MIN,GZ,EDUC	70(95%)	25(5%)	N/A	NO	COMP. BUS
E1	GOLD	O/C	40000 OZ	3	VERY HIGH	1988	80	10	90	0	65	FARMING	65(45%)	100(5%)	N/A	YES(1)	PRIVATE
F1	COAL	O/C	33000000 T	N/A	VERY HIGH	1968	5000	10	75	15	3	N/A	N/A	N/A	N/A	YES(1,2)	PRIVATE
G1	GOLD	BOTH	50000 OZ	5	HIGH	1985	120	5	70	25	1	FARMING	1(32%)	20(8%)	45(60%)	YES(2)	PRIVATE
H1	ZINC,LEAD	U/G	520000 T	15	HIGH	1935	475	10	75	15	0	N/A	0(100%)	N/A	N/A	YES(1,2)	PRIVATE
I1	IRON	O/C	1300000 T	6	VERY HIGH	1973	267	4	79	17	2	N/A	2(100%)	N/A	N/A	YES(1)	PRIVATE
J1	ZINC,CU	BOTH	120000 T	8	HIGH	1987	130	23	30	47	30	MIN,AG,EDUC	30(95%)	25(5%)	N/A	NO	COMP. BUS
K1	GOLD	O/C	43000 OZ	5	VERY HIGH	1988	87	15	85	0	50	FARMING	50(45%)	85(5%)	N/A	YES(1)	PRIVATE

Table 4. Summary of Personal Attitudes to FIFO Survey.

CONDITIONS	NO. REPLY	AVERAGE QUESTION SCORE								
		1	2	3	4	5	6	7	8	9
A	6	7.67	5.00	3.67	1.83	6.83	5.83	4.50	6.33	8.33
B	5	6.20	5.20	3.40	3.40	8.40	3.60	2.60	8.00	5.20
C	4	5.25	5.25	2.25	3.00	6.25	4.50	3.75	5.75	4.75
D	17	4.47	2.71	5.18	3.71	7.35	5.41	4.82	4.41	3.88
E	8	5.75	3.13	2.75	2.63	6.25	3.13	1.75	8.37	9.00
F	6	7.00	3.83	3.50	2.33	4.83	5.67	4.67	5.00	4.17
G	7	7.57	3.86	3.00	3.00	8.57	4.14	3.71	6.57	4.71
H	10	6.1	4.9	3.3	2.2	6	4.2	4.7	6	6.4
I	8	5.75	4.38	2.63	1.50	4.50	4.88	2.63	5.75	6.75
J	4	4	4	2.5	3	8.75	2	1	5.25	7.25
K	12	6.67	3.33	3.67	1.00	6.50	5.42	4.00	7.00	5.75
L	4	7.50	6.25	2.75	3.00	5.00	6.25	3.50	6.00	6.00
M	15	6.00	5.20	4.07	4.00	7.20	4.73	4.13	5.87	5.27
N	14	8.07	5.64	3.14	1.57	6.43	3.86	3.71	7.21	6.00
O	18	5.44	4.50	4.61	1.89	7.06	5.28	4.11	4.83	5.33
P	18	3.56	1.94	2.56	1.94	6.50	3.39	3.22	4.83	5.28
Q	5	7.40	5.20	4.80	1.80	7.80	5.00	4.60	7.20	4.60
AGGREGATE (17 MINES)	161	5.90	4.11	3.58	2.42	6.75	4.57	3.78	5.92	5.65
WORK CATEGORY										
PROFESSIONAL	62	6.28	4.00	3.30	2.39	6.36	5.05	3.74	5.98	5.66
GENERAL STAFF	20	5.79	3.89	3.79	2.00	5.11	5.16	4.06	4.95	4.32
AWARD	79	5.65	4.16	3.82	2.52	7.54	4.10	3.76	6.14	5.99
MARITAL STATUS										
SINGLE	69	6.33	3.71	3.41	2.68	7.19	4.99	3.58	6.33	5.54
MARRIED	92	5.63	4.45	3.75	2.23	6.38	4.30	3.96	5.56	5.78
WORK SCHEDULE										
1 ON 1 OFF	30	5.66	5.03	3.47	3.94	7.25	4.56	3.94	5.78	6.5
2 ON 1 OFF	71	5.93	3.81	3.49	1.93	7.34	4.52	3.74	5.99	5.49
3 ON 1 OFF	22	4.90	3.40	4.15	2.15	4.85	5.75	4.80	4.30	3.10
> 3 ON 1 OFF	38	6.61	4.31	3.56	2.19	6.17	4.03	3.14	6.81	6.61

creation of "ghost towns" needs to be considered. FIFO operations which, after establishment, prove up large reserves and lead to a long mine life may create a problem if a traditional mining town is then warranted.

The results of the survey of state Department of Mines indicated broad agreement across Australia from government officials. One government response did raise the question of health related issues resulting from extended shifts in FIFO operations. Extended shifts lead to tiredness. Also, Threshold Level Values (TLV) for exposure to contaminants are based on normal (eight hour) work shifts. One government official indicated that extended underground shifts are only allowed where good ventilation is available and methods are highly mechanised (for instance production use of air leg drills would not be accepted.) Anon, 1990 indicated that for the first time the American Conference of Governmental Industrial Hygienists had considered TLUs for "Unusual work schedules." Both the exposure (work) time and the recovery (rest) time need to be considered. They indicated that the TLV should be reduced proportionately for both increased exposure time and reduced recovery time.

Union responses indicated acceptance of FIFO only for projects which have a short life (less than five to ten years) are isolated and where the resource being exploited is low in volume, high in value (for instance, not coal). They voiced a number of reservations with the concept.

1. FIFO operators are not contributing to the training of employees. The established large mining companies with traditional towns are carrying the training load for the whole industry.
2. There is opposition to extended shift lengths, particularly in underground mines.
3. Families apart for regular and extended periods may incur social problems. While it is acknowledged that FIFO has not been in use in Australia for long enough to form firm opinions on long term social effects, there is evidence from the oil and gas industry that apart from senior ranks there are few long term employees.

The magnitude of the number of responses from mining operators, employees, government departments and unions means than any results can only be reported in a summary and general form.

ANALYSIS OF RESULTS

The study has indicated that FIFO has become an important part of the Australian mining industry. The approach has been largely adopted from the Canadian experience. Australia with 20 or more FIFO sites now exceeds the number of Canadian mines using this system. The Argyle Mine, WA, was the first major Australian mine to adopt the approach after having convinced the Western Australian government of its merits. This introduction of mining FIFO to Australia in about 1983 was a turning point. It would appear that all new Australian mines established since that date in remote areas have strongly evaluated the FIFO approach. From this evaluation, all new mines in remote areas have adopted FIFO with the following exceptions.

1. The Olympic Dam Mine, S.A., which opened in 1988 established the Roxby Downs township (it must be acknowledged, though, that much planning for this major mine had occurred before 1983.)
2. The Leigh Creek, S.A. township was resited.

From survey response population, 36 Australian mines have begun production since 1983. Eighteen of these adopted FIFO and most of the rest operate out of established country towns based on agriculture or mining. The early 1980s marked the end of the major growth phase in Australian coal mining. During these few years the "traditional" mining towns of Glenden, Tieri and Middlemount had been established. The gold mining boom which gathered momentum in the mid 1980s was different. Examination of FIFO operations in Table 2 indicates that the large majority are based on gold, with a small contribution from diamonds and base metals. Many of these have a short expected mine life although a number have five to nine years anticipated life. Probability of finding economic extensions to reserves is high to very high in some cases. About half of the FIFO operations are of significant size and have over 100 employees. Some are within driving distance of small existing towns but have decided to adopt FIFO. All utilise some form of Single Persons Quarters, some permanent and others of demountable construction.

It is of interest to note that all FIFO respondents when asked the question "If the company had its time again, would it go for a traditional town approach?" replied "No". Operations using FIFO are generally satisfied with the approach.

Non FIFO respondents to the survey produce the full range of Australia's mined commodities as indicated in Table 3. Many have extensive histories and are based around old mining cities (for instance Broken Hill, Mount Isa, Kalgoorlie) or the newer mining towns developed in the 1960s and 1970s. Many anticipate an extensive future mine life (some over 50 years) and in most cases the probability of extension to economic reserves is high. Workforce in almost all cases is a significant number and some mines have over 1,000 employees.

Most operate some form of Single Persons Quarters, although this is less likely in the older established towns. Also, most expect employees to find their own way to work although about 25 percent run a company bus. About 40 percent have employees residing in more than one town.

The question put to non FIFO operators "If the company had its time again, would it go for a FIFO approach?" produced a spread of replies. Twenty five percent responded that they would seriously consider FIFO (it was not an available option when their mine was initially started) and about 40 percent replied negatively. The remainder did not answer this section of the questionnaire - perhaps due to the lack of relevance of the question as their mine is located near an existing town.

The personal attitudes survey completed by employees broadly indicated that those working at FIFO sites favourably support the approach. There were positive indications that this group:

1. Go out of their way to seek employment at a FIFO site.
2. Would seek another FIFO job in the future.
3. Would have family support for seeking another FIFO job.
4. Like FIFO as it gives more time For hobbies and recreation.
5. Find that family relationships are, if anything, enhanced by FIFO. FIFO does not interfere unduly with personal or family community activities.

There were indications that families did not initially support selection of a FIFO job. Most Australian FIFO mining operations are in Western Australia. That state's Department of Mines has seriously examined the approach and allowed its introduction in an orderly manner. Queensland and the Northern Territory each have less FIFO operations and appear to have followed the "family positive" lead shown by Western Australia.

Unions appear to have been hesitant to endorse the introduction of FIFO. On the one hand they accept that:

1. A significant group of their membership is supportive of the approach. There are many aspects to this question. Some responses indicate that the family situation has a large bearing; the happiest FIFO employees are single persons or married couples who work the same mine shifts together. On the other hand, married employees with young children are least likely to support the FIFO approach.
2. Some orebodies, particularly small gold occurrences cannot at present be mined economically in any other way.

On the other, they have pointed out:

1. FIFO operations have little record of providing employee training.
2. Questions on safety and exposure to hazardous contaminants with extended shifts need to be addressed.
3. It is too early to say if FIFO creates a stable permanent workforce at a mine site.
4. Questions on social disruption to family life need to be addressed.

It has been pointed out that the FIFO system disadvantages Unions in communicating with membership. With extended shifts, and some members on rotation at home it is very difficult for Union meetings to be held.

FIFO is an important question which would appear to be being considered by mine operators in all remote parts of Australia. A recent new and major coal development in Queensland's Bowen Basin considered the question extensively. Although the new mine is located fairly close to an established town based on agriculture and mining, investigations were undertaken into the feasibility of using a workforce resident in Southern Queensland, before a final decision was made not to adopt FIFO. It is believed that a FIFO approach is being considered for a new iron ore mine in Western Australia. While this study was directed to FIFO in Australia, the use of FIFO in Papua New Guinea for servicing some mines from Australia is well established.

CONCLUSIONS

A study on the introduction of FIFO to the Australian mining industry has been undertaken. Responses from technically based questionnaires mailed to mine operations, employees, government Departments of Mines and Unions have been assessed.

During the 1980s FIFO has been adopted as the favoured approach for exploitation of high value, low volume mined commodities (for instance, precious and base metals) in remote Australia. Mine operators state that they support continuation of the approach. A group of the mine workforce find the FIFO arrangement to their liking. Relevant government Department of Mines have positively supported orderly introduction of the approach. Mining unions have accepted that the system is appropriate for certain sections of the Australian industry although highlighting important questions that needed to be addressed in its implementation.

FIFO has and will continue to be investigated for its application to low value, high volume mined commodities (for instance coal, iron ore and bauxite). A significant number of well established remote mining operations would seriously consider FIFO if "they could have their time again".

There is no doubt that some Australian mines would not be in existence without the adoption of FIFO arrangements. The FIFO approach has, in some sectors, created orebodies from otherwise uneconomic mineralisation. The industry adopted FIFO during the 1980s and it is a concept which is likely to be with Australian mining for some time in the future.

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