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The Increasing Acceptance of Fly-in Fly-out within the

Australian Mining Industry

A.D.S. Gillies, Hsin Wei Wu and S.J. Jones

Abstract

Australia wide, over 40 Fly-in Fly-out mining operations and other forms of Long Distance Commuting now exist, with coverage of about 5000 employees. The substantial majority of these operations are in Western Australia, with some mines also located in Queensland and the Northern Territory. In recent years new large scale mining operations have adopted the Fly-in Fly-out approach and it is important to note that no new mining towns have been constructed in Australia since the township of Roxby Downs was built in the late 1980s to service the Olympic Dam mine.

An examination of Fly-in Fly-out mining operations in Australia has been undertaken. A detailed survey undertaken in 1990 has been reviewed and another intensive survey undertaken to establish emerging trends. Results from both company and individual employees point of view have been analysed. A section examines the views of professional employees and the influence of Fly-in Fly-out on career development.

Bus-in Bus-out coal mining operations are emerging in Queensland's Bowen Basin. These operations commute their employees into the mine site for compressed working schedules whilst the mine employees' families are domiciled in regional cities such as Mackay. A review of the issues associated with the development of long distance commute coal mining operations in Queensland's Bowen Basin is performed and two case studies examined.

Introduction

In the 1980s a change in pattern occurred in the development of new mines in remote regions of Australia which saw many companies adopt a fly-in fly-out (FIFO) arrangement to servicing a mine rather than the construction of a traditional mining town (the term FIFO is used to describe fly-in fly-out, bus-in bus-out and other forms of long-distance commute mining operations). Under FIFO, 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.

Australia wide, over 40 FIFO mining operations now exist, with coverage of about 5000 employees (WA Department of Mines and Energy, 1991). The substantial majority of these operations are in Western Australia, with some mines also located in Queensland and the Northern Territory. In recent years new large scale mining operations have adopted the FIFO approach and it is important to note that no new mining towns have been constructed in Australia since the township of Roxby Downs was built in the late 1980's to service the Olympic Dam mine.

There are many reasons why the shift from constructing mining towns to adopting a FIFO approach to servicing a mine has occurred since the early 1980's. Mining companies have been unwilling to support the high construction cost of towns, short life and smaller mining operations do not justify a town (particularly small to medium scale gold mining operations), fast jet aircraft are becoming increasingly 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 decentralisation. There have also been questions raised as to the social problems which may develop from the artificial separation of the "breadwinner" from his family.

A change in the economic viability of some new mining projects has been brought about by this move from traditional town to the FIFO approach to the servicing of the operation. This change has been attributed to the reduced capital cost associated with not having to build a town near the mining operation. In recent years even new 'bonanza' mine developments such as BHP Minerals' Cannington lead/zinc/silver project have decided to adopt a FIFO approach to their planned operations.

Background

A thorough survey of how FIFO was affecting the Australian mining industry was undertaken in 1990 (Gillies, Just and Wu, 1991). To gain an appreciation of the impact that FIFO was having on the Australian mining industry, four main groups, namely mining operators (both traditional town and FIFO operations), FIFO mining employees, state mines departments and unions, were surveyed by letter and questionnaire.

Survey Results

Fifty six mine operators responded to the survey and a breakdown of the responses indicated:

1 38 operations were serviced by a traditional town and 18 operations were FIFO.
2 25 operations were gold or gold, copper and silver mines.
3 35 operations were open pit, 12 were underground and 9 used both mining methods.
4 36 operations were established since 1 January, 1983. All 18 FIFO operations were included in this category.

An interesting finding of the mining operator survey was that when the FIFO operators were asked the question " If the company had its time again, would it go for a traditional town approach?", all FIFO operators replied "No", indicating that

all FIFO companies were happy with the decision to go for a FIFO approach to the servicing of their mining operation. When the same question was put to traditional town mining companies, 25 percent responded that they would have seriously considered FIFO if they had their time again. 40 percent of companies stated that they would not have adopted a FIFO approach to their operation if they had their time again, and the remainder did not answer the question, probably as the question was not relevant (eg an established town already existed near the mining operation when the operation commenced production).

The personal attitudes to FIFO survey that was completed by FIFO employees broadly indicated that FIFO employees favourably support the FIFO approach. There were positive indications from the individual survey results that this group go out of their way to seek employment at a FIFO operation, would seek another FIFO job in the future, would have family support for seeking another FIFO job, like FIFO as it gives them more time for hobbies and recreation and found that family relationships, if anything, are enhanced by FIFO.

The results of the survey of the State Department of Minerals and Energy in Western Australia raised the question of health related issues resulting from extended shifts and compressed working schedules in FIFO mining operations. Extended shifts led to tiredness, especially near the end of a shift. Also, Threshold Level Values (TLVs) for exposure to contaminants are based on normal eight hour working shifts. One Western Australian government official stated that extended shifts in underground mines are only allowed where there is sufficient ventilation to dilute contaminants to lower then TLV levels.

Unions do not appear to be happy with the FIFO approach to mining operations. On the one hand they accept that a large portion of their membership are supportive of FIFO mining operations and some orebodies, especially small gold orebodies, cannot be mined economically any other way, but on the other hand, they pointed out that FIFO operations have little record of providing employee training, questions need to be addressed with regards to exposures to hazardous contaminants over extended shifts and compressed working schedules, it is too early to say whether FIFO creates a stable permanent work force at a mine site and questions on social disruptions to family life need to be addressed. It has been pointed out that the FIFO system disadvantages unions in communicating with their members. With extended shifts, and some members on rotation at home, it is very difficult for union meetings to be arranged and attended.

The Updated Survey

An updated and extended survey of the impact of FIFO mining operations on the Australian mining industry was circulated during 1996. The survey consisting of several sections was sent to five key groups that are part of the Australian mining industry. These groups were mining operators (both traditional town and FIFO operations), FIFO mining employees, state mines departments, Australasian Institute of Mining and Metallurgy (AusIMM) branches and unions.

Mining Operators

Three questionnaires were prepared to survey opinions. The main survey related to the company situation. This company survey was sent to both FIFO and traditional town based mining operations to determine the differences between the two types of operations.

FIFO Employees

A second and third survey was also sent to FIFO mining operations. The second survey was for individuals such as non-professional and award workers, whilst the third survey was for professional employees of the company. The results of these surveys are discussed in the individual FIFO employee section of this paper.

State Government Departments of Mines and Energy

A questionnaire was also prepared for the State Departments of Mines/Minerals and Energy of Western Australia and Queensland and the Northern Territory to gauge their views on FIFO.

AusIMM Branches

AusIMM branches were asked to respond to a letter aimed at gauging attitudes of AusIMM members to FIFO mining operations. AusIMM branches were also asked to detail how FIFO affects their members participation in branch activities. The results of these surveys are discussed in the section of this paper entitled “The Implication of FIFO on Professional Career Development”.

Relevant Trade Unions

A letter was also prepared for trade unions that cover the work force of mining operations to gauge their views on FIFO. No trade unions responded to the letter.

Results of the Company Survey

Approximately 100 mining operations were approached to complete the company survey and 48 operations responded. This was considered a good response considering the size of the survey that was circulated (17-pages). A breakdown of the responses indicated:

1 33 mining operations was serviced by a nearby town

2 14 operations were FIFO and 1 operation was bus-in bus-out
3 20 operations were solely producers of gold bullion and 7 operations were solely producers of coal
4 25 operations were open cut, 12 were underground and 11 were both open cut and underground

Tables 1 and 2 are summaries of the responses of the 15 FIFO operations and 33 Non-FIFO operations respectively. The tables include data on the characteristics of each mining operation final mine product, mining method, annual production, expected mine life (based on present reserves), probability of mine life extension, number. of 1996 employees and the work force distribution grouped by professionals, non-professionals and contractors.

The company survey revealed that in most cases several key reasons were associated with the decision to adopt either a FIFO or a traditional town based operation. The majority of FIFO mining operations expressed the views that the reduced capital requirements for the FIFO arrangement was the main factor in the decision to operate a FIFO mining operation. Some mines stated that there was simply no option between the FIFO and a non-FIFO approach to the operation as the ore reserve was not economic if a town had to be constructed near the mine site. Several other factors were identified by FIFO mining operations as contributing to the decision to adopt a FIFO approach to their mining operation such as the potential to attract a higher quality work force, the ability to control the shift start-times of employees when at the mine site and a reduction in the absenteeism problem that is experienced at many town based mining operations.

Traditional town based mining operations responded to the question of why they did not adopt a FIFO arrangement to service their mine by stating that either an existing town was already established near the mine site when the mine was developed or the mining town that was constructed to service their operation was established before FIFO was a recognised project development option, and that if the ore resource was discovered today, FIFO may have been considered. When non-FIFO mining operations were asked the question "If the company had its time again, would it consider going for a FIFO approach?", 30 out of 33 companies responded, with six mines replying that they would "seriously consider" such an option, six mines replying they "would consider" such an option, one mine replying that they "would not consider" such an option and 17 mines replying with "not relevant" (ie the mine site is located near an already established town). When FIFO mining operations were asked the same question, all but one operation responded that they "would not" change their decision to adopt a FIFO approach to their mine. A bus-in bus-out operation in Western Australia replied that they would "quite likely" change their decision to adopt a FIFO arrangement if they had their time again.

An attempt was made to determine the impact that living in remote locations has on employee motivation and family social problems. The FIFO companies generally responded that FIFO is a positive influence on employee motivation, employees can however get tired on long rostered on periods and FIFO is very difficult for employees with young children and when illness occurs in the family when on roster at the mine site. The remote town based operations (10 mines) responded that particular social problems identified were the lack of high quality schooling, the retention of high quality teachers and the lack of jobs for school leavers in single industry mining towns.

FIFO operations more often than not believed that the ability to attract a higher quality work force to their operation was a positive aspect of FIFO, however, this view was not unanimous. Some traditional town based mining operations claimed that they were more able to attract prospective employees to their operations than FIFO operators. There was general agreement amongst FIFO operators that high rates of pay and the ability to spend days off in capital cities or regional capitals was the main attraction to the FIFO lifestyle. It was also generally agreed that prospective employees with young families were less attracted to the FIFO lifestyle. Mining town based operations believed that prospective employees were more attracted to work at their operations because of the daily family contact that resulted from employees families living near the mine site.

Only six FIFO operations responded that they could quantify their professional employee turn-over rates, with the highest rate being 60 percent per annum and the lowest being nil in the previous 12 months. The non-professional employee turn-over rates of these operations ranged from the highest rate of 90 percent to the lowest of only two employees in the previous 12 months. No FIFO operations were aware of any industry wide data that detailed employee turn-over rates in FIFO operations.

Twenty-four traditional town based mining operations replied that they could quantify their professional employee turn-over rates. Within the previous 12 months the highest turn-over rate recorded was 30 percent per annum, the lowest nil and the average turn-over rate was approximately 20 percent per annum. Twenty-two mining town based operations replied that they could also quantify their non-professional employee turn-over rates. The highest rate recorded was 28 percent, the lowest nil with the average at 18 percent. The majority of traditional town based mining companies replied that they were unaware of data that was available from industry organisations that detailed professional and non-professional turn-over rates in the various mining industry sectors.

It could be concluded that labour turn-over rates at FIFO operations are generally much higher than those at town based mining operations. However it must be concluded that only a small amount of data was available for analysis. Employee training levels at both FIFO and non-FIFO mining operations were hard to compare, as many different training level measuring systems are currently being used in the mining industry.

Table 1 Summary of Company Survey Data for FIFO Mines

Mining Operation			Annual	Expected Mine Life	Probability of Mine	No. of Employees	Workforce Distribution (%)		
Name	Final Mine Product/s	Mine Type	Production	(Present Reserves)	Life Extension	(1996)	Prof.	Non-Prof.	Contractors
1	Gold Bullion	O/C & U/G	210,000oz Au	9 years	High	337	9	56	35
2	Gold Bullion	O/C & U/G	180,000oz Au	15 years	Very High	450	5	20	75
3	Copper Cathode	O/C	9,500t Cu	10 years	Very High	140	20	40	40
4	Gold Bullion	O/C	60,000oz Au	1 year	Very High	130	20	50	30
5	Gold Bullion	O/C	70,000oz Au	3 years	High	133	N/A	N/A	N/A
6	Gold Bullion	O/C	42,500oz Au	2 years	High	150	15	20	65
7	Gold Bullion	O/C	250,000oz Au	3 years	Very High	370	10	30	60
8	Gold Bullion	O/C & U/G	200,000oz Au	8 years	High	372	18	40	42
9	Gold Bullion	U/G	N/A	7 years	High	235	14	22	64
10	Cu & Au Conc.	U/G	N/A	5 years	High	320	10	60	30
11	Gold Bullion, Cu Conc.	O/C	155,000oz Au	1 year	High	92	16	76	11
12	Gold Bullion	O/C	40,000oz Au	3 years	High	26	13	32	57
13	Gold Bullion	O/C	240,000oz Au	6 years	High	300	9	21	70
14	Gold Bullion	U/G	50,000oz Au	3-5 years	Very High	160	10	15	75
15	Cu, Zn, Ag & Au Conc.	U/G	900,000t ore	8 years	Moderate	350	N/A	N/A	N/A

Table 2 Summary of Company Survey Data for Non-FIFO Mines

Mining Operation			Annual	Expected Mine Life	Probability of Mine	No. of Employees	Workforce Distribution (%)		
Name	Final Mine Product/s	Mine Type	Production	(Present Reserves)	Life Extension	(1996)	Prof.	Non-Prof.	Contractors
1	Crushed Iron Ore	O/C	27Mt	35 years left	Moderate	1400	8	78	14
2	Zn, Pb, Cu, Ag, Au Conc.	U/G	570,000t ore	6 years	Very High	370	10	80	10
3	Tin Conc.	U/G	8,200t tin in conc.	12 years	Moderate	295	12	71	17
4	Coking and Thermal Coal	O/C	5.0Mt	30 years	Moderate	510	25	75	0
5	Cu, Pb & Ag Metal, Zn Conc.	U/G	N/A	>30 years	High	3000	30	60	10
6	Gold	O/C & U/G	N/A	N/A	N/A	570	35	35	30
7	Coking and Thermal Coal	O/C & U/G	2.8Mt	>25 years	Very High	550	20	70	10
8	Copper & Zinc Conc.	U/G	280,000t ore	Closing 31/7/96	Very Low	70	26	74	0
9	Gold Dore Bar, Copper Conc.	U/G	250kt ore, 45000oz Au	6 years	Very High	70	N/A	N/A	N/A
10	Kaolin, Bauxite, Calcinated Bauxite	O/C	8Mt Bauxite	N/A	Moderate	760	N/A	N/A	N/A
11	Base Metal Concentrates	U/G	362,000t ore	4 years	Low	216	39	46	15
12	Gold Bars	O/C & U/G	60,000oz Au	1 year	Moderate	100	20	30	50
13	Crushed Bauxite, Alumina	O/C	6.5Mt Bauxite	40 years	Moderate	1150	25	25	50
14	Uranium Oxide Powder	O/C	3,000t Uranium Oxide	10 years	Very High	180	40	60	0
15	Gold Bullion	O/C & U/G	150,000oz Au	20 years	High	190	18	27	55
16	Coking Coal, ULV Coal	O/C	4.5Mt	15 years	Moderate	490	7	93	0
17	Copper Cathode	O/C	15,000t Cu	5 years	Very High	100	15	30	55
18	Coal	O/C	2.8Mt	>15 years	High	386	24	76	0
19	Coal	O/C & U/G	4.35Mt	+20 years	Moderate	503	20	71	9
20	Gold Bars	O/C & U/G	700,000oz Au	22 years (open cut)	Very High	1 100	30	30	40
21	Pb, Zn, Ag Ore	U/G	1.2Mt ore	< 5 years	High	250	20	75	5
22	Pb & Zn Conc.	O/C & U/G	2.6Mt ore	15 years	Low	800	39	60	1
23	Crushed & Washed Magnesite	O/C	270,000t	30 years	Very High	66	6	44	50
24	Gold Bullion	O/C	1.3Mt ore, 75000oz Au	2-3 years	High	N/A	25	25	50
25	Gold Dore Bullion	O/C	85000 - 95000oz Au	7 - 8 years	High	45 - 50	15	30	50
26	Cu, Pb & Zn Conc.	U/G	500,000t ore	3 years	N/A	190	20	70	10
27	Sinter Fines (Iron Ore)	O/C	28Mt ore	< 30 years	High	735	N/A	N/A	N/A
28	Coking Coal	O/C	5.0 - 5.5Mt	< 15 years	High	606	10	90	0
29	Washed Coal (Thermal Wear Coking)	O/C	4.4Mt	15 - 20 years	High	497	22	68	10
30	Gold Bullion	O/C & U/G	100,000oz Au	3 years	Moderate	185	10	30	60
31	Gold Dore Bullion	O/C	80,000 - 110,000oz Au	3 years	Very High	100	10	20	67
32	Gold & Silver Dore Bullion	O/C	230,000oz Au	4 years	Moderate	164	7	38	55
33	Coal	O/C	11Mtpa	+20 years	High	1140	20	80	0

Table 3 shows the non-professional and professional rosters that were being utilised at the 15 FIFO mining operations that responded to the survey. It was established that a two weeks on/ one week off roster is the most popular with 66 percent of employees currently working under this arrangement.

Table 3 Non-professional and professional employee rosters at FIFO mines

Mine Name	Non-Professional Employee Rosters	Professional Employee Rosters
1	2 wks on/1wk off or 9 days on/5 days off	9 days on/5 days off
2	6 wks/1 wk off	2 wks on/1 wk off
3	2 wks on/1 wk off to 6 wks on/1 wk off	5 days on/2 days off to 2 wks on/1 wk off
4	1 wk on/1 wk off	2 wks on/1 wk off
5	2 wks on/1 wk off	10 days on/4 days off
6	2 wks on/1 wk off or 3 wks on/1 wk off	2 wks on, 1 wk off
7	2 wks on/1 wk off or 9 days on/5 days off	9 days on/5 days off or 5 days on/2 days off or 4 days on/3 days off
8	2 wks on/1 wk off	2 wks on/1 wk off
9	2 wks on/1 wk off	5 days on/2 days off or 9 days on/5 days off
10	2 wks on/1 wk off	5 days on/2days off
11	7 days on/7 days off	5 days on/2 days off then 4 days on/3 days off
12	2 wks on/1 wk off	2 wks on/1 wk off
13	4 wks on/1 wk off or 2 wks on/1 wk off	2 wks on/1 wk off
14	2 wks on/1 wk off	2 wks on/1 wk off
15	N/A	N/A

FIFO operations generally believe that their employees are more productive than equivalent employees based at traditional mining town operations. This view is held mainly due to the fact that FIFO operations believe that the utilisation of 12 hour shifts is more productive. The most popular 12 hour shift roster system utilised by FIFO mines was two weeks on and one week off. Traditional town based operations also generally believed that their employees are more productive than equivalent FIFO employees despite the use of far less 12 hour shift roster systems.

Some FIFO operations believed that it was easier to obtain environmental approval for their project, due to the reduced environmental disturbance associated with not constructing a town to service their mine. FIFO operations that were located near aboriginal sacred sites also believed that local aboriginal people were more willing to approve projects due to the reduced disturbance associated with not constructing a town.

Results of the Government Survey

The Western Australian Department of Minerals and Energy (Torlach, 1996) responded to the survey. He stated that the WA Governments views on FIFO have not change significantly since the 1990 University of Queensland FIFO Survey. The Department does not like extremely long work periods, for example 13 weeks on and 1 week off. The government will warn mines that employ greater than 6 weeks on and 1 week off to change their roster. Concerns were raised that there are not enough statistics available on safety performances under compressed work schedules with about10 recorded incidents of FIFO employees falling asleep while operating mobile equipment over the last 12 months.

It was also acknowledged that FIFO tends to continue to promote high centralisation which is against the government's development goals, although the WA government wishes to keep out of having to provide mining town infrastructure costs.

The WA government displayed concern in the 1990 FIFO survey that Threshold Level Values (TLVs) for exposure to contaminants are based on normal eight hour working shifts. One Western Australian government official stated that extended shifts in underground mines are only allowed where there is sufficient ventilation to dilute contaminants to lower than TLV levels. A series of guidelines have recently been released by the Western Australian Chamber of Minerals and Energy that detail how to effectively manage mine employees' exposures to contaminants. Key points are that mine operators should:

1. Engineer out exposures as far as is reasonably practicable.
2. Determine task characteristics and establish exposure parameters.

3. Adopt the ALARA (As Low As Reasonably Achievable) principle where exposures constitute a health hazard.
4. Develop multi-skilling to enable job rotation.
5. Provide appropriate protective equipment when all other approaches have not eliminated the exposure.
6. Provide training to ensure control measures are understood and acted upon.

The Updated Individual Survey

All FIFO mining operations sent a company survey also received 30 individual employee survey sheets for distribution. Twenty of these surveys were aimed at non-professional employees while the other ten surveys included four additional questions that were aimed at professional FIFO employees. Personal details of each survey respondent were obtained to assist in the analysis of different FIFO employee groups (such as married and single groups) and the following questions were then asked of each FIFO employee surveyed (with employees asked to respond to each question with an answer on a scale of one to ten, with one being "completely disagree", five "impartial" and ten "completely agree").

(a) I selected this job because I personally like the FIFO arrangement
(b) I selected this job because my family like the FIFO arrangement
(c) I would have applied for the same position in a traditional mining town environment
(d) My immediate family relationships have been seriously disadvantaged by my FIFO arrangements
(e) I like the FIFO arrangement because it gives me time for hobbies and recreational activities
(f) I find that FIFO arrangements are a major personal interference to community activities such as church, education and sport
(g) I find that FIFO arrangements are a major family interference to community activities such as church, education and sport
(h) If I change jobs, I will actively seek another FIFO operation
(i) If I change jobs, my family would fully support me in seeking out employment at another FIFO operation

The following four additional questions were asked of all professional FIFO employees. (Analysis of responses to these questions is included within the professional career development section of this paper):

(j) I feel that FIFO enhances my ability to be undertaking formal advanced study (eg part-time university)
(k) I feel that FIFO enhances my ability to interact with other professionals and participate in activities of professional societies (eg AusIMM, IEAust)
(l) I feel that I gain more professional satisfaction from employment at a FIFO mine, rather than a traditional operation
(m) I feel that there are benefits to overlapping with professional (equivalent) colleagues on other rosters

A total of 227 FIFO employees completed individual questionnaire, with 107 of these being professionals. Table 4 shows the frequency of response from for each question and the total survey responses for each question. There did not appear to be any significant differences in the responses given by survey respondents when grouped by marital status, age groups, roster type and whether respondents have children. This leads to the conclusion that attitudes to FIFO are generally similar across different categories of FIFO employees. There is evidence that a large number of FIFO employees like the FIFO arrangement. Also a large number of employees stated that they are impartial to this question. This may be expected as many people will consider that FIFO is "just another job".

A large portion (approximately 30 percent) of the survey respondents believe that their family categorically do not like the FIFO employment arrangement. Another significant proportion of the respondents were impartial to this question possibly due to the fact that single people don't have a wife and children who can like or dislike FIFO.

	Frequency for each Question												
Response	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)
1	24	62	63	57	32	39	46	24	23	24	24	17	11
2	6	4	11	18	13	13	12	9	2	12	13	4	3
3	6	9	11	26	12	16	16	12	13	9	11	8	2
4	2	9	15	10	5	7	5	7	7	5	6	6	2
5	67	74	40	48	35	57	77	71	64	29	38	38	27
6	12	5	9	9	10	12	13	6	3	6	1	5	8
7	23	12	13	10	21	19	8	14	16	5	6	7	11
8	23	13	14	14	26	21	15	23	16	8	4	7	15
9	5	0	2	2	6	4	2	7	7	1	0	5	6
10	59	18	47	27	66	37	12	54	59	5	2	10	20
Total	227	206	225	221	226	225	206	227	210	104	105	107	105

Table 4 Frequency of each response for each question

Twenty eight percent of employees surveyed would definitely not seek employment at a traditional town based mining operation while 22 percent of surveyed employees definitely would seek employment at a town based mining operation.

A large proportion of FIFO employees believe that their families have not been seriously disadvantages by their commute employment with 26 percent of respondents completely disagreeing with question (d). The majority of FIFO employees agree that on periods away from the mine, the opportunity to adequately pursue certain hobbies and other recreational activities exists. It is clear from the survey responses that FIFO employees generally believe that their families are not prevented from participating in community activities due to the fact that they are permanently based in a regional or state capital city.

Twenty four percent of respondents stated that they would definitely seek employment at another FIFO operation if they changed jobs, whilst only ten percent of FIFO employees totally disagreed. This indicates that there is evidence that the majority of FIFO employees would seek another FIFO job. The analysis of survey responses also shows that FIFO employees families would also generally be supportive of further employment in other FIFO operations.

The Split Viewpoint Hypothesis

It can clearly be seen when histograms are drawn for responses from one to ten for each question (as in the histogram for question (a) as shown in figure 1) that the shape of each questions histogram is tri-modal. This means that there is a significant peak in each question histogram at the responses of one, five and ten. It is quite clear from the tri-modal shape of each graph that a large portion of FIFO workers either greatly dislikes, is impartial to or greatly likes FIFO.

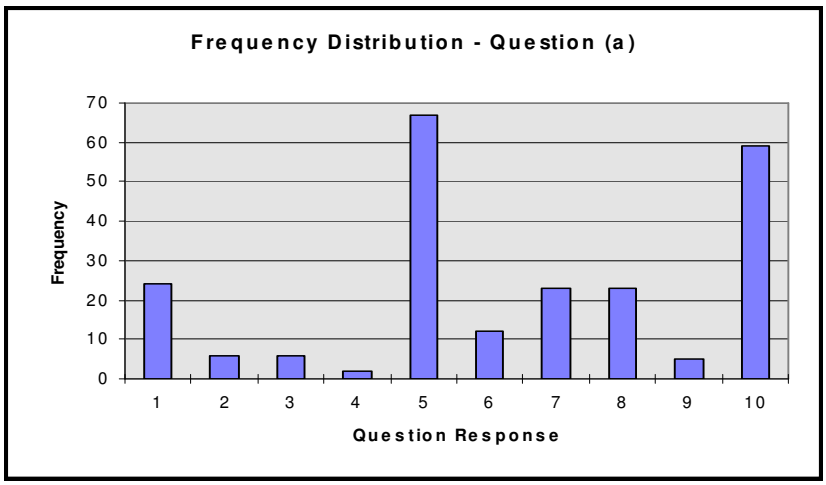

Figure 1 Histogram of Responses for Question (a)

The tri-modal nature of responses to FIFO employment may be an explanation for the high turn-over rates that are experienced at most FIFO operations. When a FIFO operation is established, a large pool of city based workers are initially employed by the operation and begin to commute to the mine generally working compressed work schedules. Initially, and as emphasised by the tri-modal nature of responses to FIFO employment, a significant number of employees find that they greatly dislike FIFO, another significant percentage of employees are impartial to FIFO and a significant number of employees will greatly like their FIFO employment. The employees that greatly dislike the FIFO nature of the operation will tend to leave the operation soon after commencement of their employment. Labour turn-over rates will therefore be high in the first few years of the operation. As new employees take up the positions of those that resign in the first few years of the operation, the new employee population response will also be tri-modal and thus a significant number of these employees will also resign after a short time period working at the FIFO operation. It is therefore expected that the high labour turn-over rates will slowly reduce as the percentage of employees that greatly like the FIFO arrangement increases over the life of the mine. Thus, labour turn-over rates are expected to stabilise after a few years. There is evidence that this has occurred in the longer established FIFO mines that are operating in Canada. Two well established Australian FIFO mines, the Argyle diamond mine and Red Dome gold mine, have consistently experienced low turn-over rates for many years. However, in the short life (less than five years) FIFO mining operations that are established to develop small gold deposits, labour turn-over rates may not stabilise before the mine ceases production.

There are no doubt other reasons why FIFO operations generally have such high labour turn-over rates. It is clear that the work roster greatly influences the labour turn-over rate, with the Argyle diamond mine and Red Dome gold mine, which utilise symmetrical rosters of (14 days on/14 days off) and (7 days on/7 days off) respectively, experiencing very low labour turn-over rates. FIFO operators must weigh up the benefits of the perceived reduced labour turn-over associated with employing a symmetrical roster (meaning that workers are only utilised 50 per cent of the time) over employing an unsymmetrical roster (such as two weeks on/one week off) under which employees are utilised a greater percentage of the time and consequentially a smaller total workforce is required. The quality of the accommodation that is provided on the mine site to FIFO employees appears also to be an important factor in retaining employees. The costs associated with building different quality mine site camps/hostels over the costs associated with the differing labour turn-over associated with different quality

accommodation may be worthy of examination. Other factors such as the relationship between workers and management, the level of multi-skilling and job rotation performed on site and the remuneration levels of employees contribute to the degree of labour turn-over on any mine site. Consequently, it is difficult to establish a direct quantifiable link between turn-over rates, FIFO shift rosters and the quality of the camp/hostel on the mine site.

It is evident that low labour turn-over rates are far more crucial in underground mining, due to the greater demands for the retention of the skilled labour that are needed to sustain high underground mining productivity levels. Some people would claim that it is relatively easy to train a new employee to drive a haul truck or operate a loader and more difficult to train a new employee to operate a drilling jumbo or a continuous miner efficiently.

The Implication of FIFO on Professional Career Development

Several AusIMM branches were approached with the goal being to obtain individual branch views on FIFO and how it affects their AusIMM member's professional career development. The following were put to branches:

1. Attitudes to FIFO mining operations as opposed to the traditional town concept.
2. Attitudes to future FIFO mining developments.
3. Do members believe that FIFO enhances ability to be undertaking formal advanced study (eg part-time university)?
4. Do members believe that FIFO enhances ability to interact with other professionals and participate in activities of AusIMM branches such as technical sessions and social functions?
5. Do members feel that they gain more professional satisfaction from employment at a FIFO mine than a traditional operation?
6. Do members feel that there are benefits to overlapping with professional (equivalent) colleagues on other rosters at FIFO operations?
7. What problems now and in the future are seen for the professional and AusIMM activities if more FIFO mining operations are developed?

Results of Questions to AusIMM Branches

Twelve AusIMM branches and/or Branch representative members responded to the survey. There was a general feeling that due to simple project economics FIFO is here to stay. Views as to the social ramifications of FIFO were expressed by several respondents, although generally attitudes were similar to those expressed in the results of the company survey. The survey respondents unanimously agreed that FIFO mining operations would continue to be developed where remote ore reserves are discovered. One respondent stated that companies would have to accept the high labour turn-over rates that are associated with FIFO in order to reduce the up-front development capital costs associated with mining projects.

Several respondents believed that FIFO enhances professional mining employees ability to undertake formal advanced study. This is due to the fact that whilst at the mine site there is little else to do in times off shift. However, with twelve hour shifts there is little time to study. Fly-out times can be spent studying, and university resources, such as libraries, can be accessed more easily. It is evident that FIFO rosters are the main influence on the ability of FIFO professionals to pursue further advanced study. With unsymmetrical shifts it is evident that extensive formal advanced study would be difficult.

The overwhelming majority of respondents believed that FIFO did not enhance the ability of professional employees to participate in AusIMM branch activities. This is due to the fact that FIFO employees are absent from branch based towns for a large proportion of AusIMM activities due to compressed work schedules. Some respondents stated that attendance at AusIMM activities was only possible in fly-out periods and thus the roster of the employees dictated the number of AusIMM branch meetings and activities that could be attended each year. It is also believed that increasing numbers of FIFO employees are choosing to have homes outside city areas such as in coastal resort communities an hour or two travel time from major urban centres. These people face an additional disincentive to attending city AusIMM branch meetings in their fly-out roster times.

A large proportion of respondents stated professional satisfaction from employment at a FIFO mine was no different to that of a traditional town based mine. However, the high turn-over rates associated with FIFO can provide better promotional prospects for professionals and after work socialising (that is more extensive than occurs in traditional town based operations where the employees go home to their families) can result in thorough discussions of technical issues that may lead to a high degree of professional satisfaction. There was general agreement from the survey respondents that there are benefits to overlapping with professional (equivalent) colleagues on other rosters in FIFO operations. The possibility of personality conflicts between equivalent colleagues on overlapping shifts could cause problems, but this is obviously a management challenge. There was general agreement among the survey respondents that more FIFO mining operations may lead to less involvement by mining professionals in AusIMM branch activities and meetings.

Four of the questions asked in the individual FIFO employee survey were aimed at professional employees and aspects of professional development. It became clear from the analysis of these questions that the majority of FIFO professional employees believe that the commute style of their employment is a hindrance to pursuing further formal advanced study, FIFO professionals don't gain any more or any less professional satisfaction from a FIFO operation over a town based mining operation, FIFO employment hinders interaction with other professionals through organisations such as the AusIMM and FIFO professionals generally believe that they can obtain professional satisfaction from overlapping with equivalent colleagues on other rosters. These individual professional employee responses thus paralleled AusIMM branch replies.

The Queensland Coal Industry

The FIFO approach to servicing mining operations has become well established in the metalliferous mining sector. This same approach is now becoming the chosen project development option for several coal mining companies in Queensland's Bowen Coal Basin. It is understood that Arco Australia Inc. looked at developing a FIFO approach to the servicing of their new Gordonstone mine in the late 1980s. Although the proposed Gordonstone mine was near to the already established town of Emerald, a study was performed on the feasibility of flying workers from Brisbane to service the mine with a FIFO system. A decision was finally made to construct additional housing in Emerald to accommodate the Gordonstone work force and it is believed that an important factor in this decision was political pressure that was placed on the company.

In the early 1990s a decision was made to adopt a bus-in bus-out approach to the servicing of the North Goonyella underground longwall coal mining operation. At about the same time the Ensham coal mining operation made a similar decision. Portman Ltd. are currently proceeding with the Burton Coal mine that will be bus-in bus-out from Mackay. However, Shell Coal Australia have recently made the decision to extend the town of Moranbah to accommodate its work force for the new Moranbah North underground longwall coal mining operation. Interviews were conducted with staff of the North Goonyella coal mine (Flannery, 1996) and the Moranbah North coal mine (Stay, 1996) to determine reasons why these two mines have taken differing domicile options for their employees.

The North Goonyella FIFO Operation

The North Goonyella mine is located between the existing mining towns of Moranbah and Glendon and is operated by White Mining Ltd. The Moranbah township services the BHP mines of Peak Downs and Goonyella/Riverside. The Glendon township services the Newlands' coal mine operated by MIM Holdings. Several project development options were initially considered for the North Goonyella mine including extension of the towns of either Glendon or Moranbah to accommodate the North Goonyella work force. Both options involved the considerations of road, pipeline and dam construction costs. An economic analysis determined that the cheaper project development option was to extend the town of Glendon.

A survey was undertaken to determine whether a suitable work force could be found that would be willing to be based in Glendon. The survey indicated that the North Goonyella mine would have considerable difficulty in attracting a quality work force to its operation if the employees and their families were based in Glendon. The bus-in bus-out of Mackay option was then seriously considered as it was also indicated in the survey that skilled mine workers would be willing to be based in Mackay and commute to the mine site for compressed working schedules.

The Newlands' mine at that stage was experiencing some financial difficulty. There was a perception that operations at Newlands may be terminated within the next decade. The North Goonyella management came to the conclusion that considerable risk was associated with extending the town of Glendon as if the Newlands' mine did close they would be left to manage a virtual ghost town. Consequently, a decision was made to adopt a bus-in bus-out arrangement for the servicing of the mining operation.

The North Goonyella management took a considerable risk in adopting this approach to the servicing of the mine. Several new underground coal mines are currently coming into production in Central Queensland and thus if North Goonyella mine employees were not happy with the FIFO approach they may have left the mining operation "in droves" to take up employment at other coal mines.

The original shift roster was six daily nine hour shifts followed by three days off in Mackay. This roster was perceived by management to be the most productive. It was considered that in the last few hours of a twelve hour shift underground employees, particularly in development, would become tired and unproductive due to the very labour intensive nature of development coal mining. Mining workers pressured the company into adopting a four days on/four days off shift roster to allow rostered employees to spend four out of every eight days in Mackay. This involved the adoption of 12 hour working shifts which the company and the unions were against at the time due to issues such as safety and productivity. Despite opposition from North Goonyella management and union officials, the 4 x 12 hour shift roster was adopted after a Coal Industry Tribunal hearing due to its roster being the favoured option of mine employees.

Two options were given to prospective North Goonyella employees when they were offered positions with the company. Option one was employees could live in Glendon with the company providing a house at $30/week. One mine employee currently utilises this option. The other option was that employees can live where they like with the company providing a bus from Mackay to/from the mine at the start and end of each roster period. The company also provides a $150/week rent subsidy for the first six months of employment to allow employees to decide where they want to live with the company then providing $5000/year for ten years to each employee to assist in mortgage payments. North Goonyella also provides free accommodation and meals at the mine site for the four days compressed working schedule.

Results of the North Goonyella Experience

(Flannery, 1996) stated that reduced capital cost associated with the FIFO option was not the most important factor in the decision to adopt this approach. Profitability of underground coal mining is particularly sensitive to the level of production per annum and thus production rates are the key to a successful coal mining operation. The retention of highly skilled underground mining employees is crucial to the success of the North Goonyella operation. The mine faces a number of technical challenges. The longwall is mining a 4.5 m thick coal seam (an extraction thickness which is high by world

standards), roof and floor conditions are poor, the coal is relatively soft and several faults have been encountered in the mining process which have led to roof falls. A group of 260 were originally employed to operate the mine. However, due to the difficult ground conditions experienced underground, a work force of 350 employees is currently required. The same coal mine under good conditions may require approximately 200 employees for the same output. It is crucial to have experienced mining crews operating the mine to minimise stoppages associated with problems such as roof falls.

The employee turn-over rate to date has been about 1 percent per annum. This is considered to be low by industry standards. However quantification of turn-over rates for underground coal mining operations in Queensland is very difficult. The low North Goonyella turn-over rate can be directly associated with the FIFO arrangement for servicing of the mine. A recent survey of spouses of the mine employees has shown that the wives and children of the workers are generally very happy with living in Mackay and a move back to a Central Queensland mining town would be very unpopular.

The mine has a small office in Mackay where some technical staff are based. A company vehicle makes the drive to the mine on most days to commute technical staff to and from the mine. With the short travel time to the mine from Mackay (about two hours), if a family member of a mine employee becomes ill while the employee is rostered on at the mine site, a company car is made available for the employee to commute back to Mackay. The absentee rate associated with the mine is about the same as a town based coal mine, with workers who are sick at the start of their rostered time on being driven out to the mine when they recover, conditional on availability of a vehicle. It was thought that 12 hour shifts may lead to accidents in the last few hours of each shift due to tiredness. The evidence shows that this is not the case with most accidents happening at the start of roster periods.

The longwall production at the mine to date has been to expectation while the development rate has been below that required to keep ahead of the longwall and thus additional development continuous miner and shuttle car units have been required. (Flannery, 1996) expressed the views that 12 hour shifts are partly responsible for the slow development advancement rates although the main contributing factors are the major technical problems of poor ground conditions and faulting.

The North Moranbah Project Development Decision

The Moranbah North underground longwall coal mine will be developed approximately 12 km north of the existing Moranbah township. It was decided to locate the planned work force of 180 employees in the town of Moranbah which will be extended at a cost of approximately $54 million dollars. This is in comparison to the $16 million spent by the North Goonyella operation on their mine camp which accommodates a work force of 320.

The two alternatives that were looked at by Shell in relation to the domicile of the Moranbah North work force and their families were to build a conventional coal mining "town" as an extension of the existing Moranbah community with families domiciled permanently in Moranbah or to domicile families in a larger regional centre (eg Mackay) and bus employees in and out of the mine.

Stay (1996) gave the following summary of major points that emerged from the company analysis of work force domicile alternatives:

1. Most recent metalliferous developments particularly in Western Australia have utilised a FIFO system. In many cases this has been combined with the implementation of a 12 hour shift roster. These locations are geographically extremely isolated.
2. The most common rosters used by commute operations are "even time", that is, employees have equal numbers of days at work and days off. Rosters which require longer periods of attendance at work away from families and shorter breaks tend to result in a high turnover of labour.
3. Since FIFO operations are frequently combined with extended hours of work (eg 12 hour shifts), it is difficult to isolate the degree to which safety and productivity performance are affected by the commute aspect of the operation.
4. It was well known that senior North Goonyella management had given evidence to the Coal Industry Tribunal that from a purely business perspective the optimum arrangement for North Goonyella was a seven day roster of nine hour shifts with the work force domiciled in Glendon or Moranbah.
5. The FIFO commute option was chosen for North Goonyella on the basis that the possibility of living in a coastal town (Mackay) combined with extended periods of leisure time could attract labour to the operation.
6. Commute may be appropriate for North Goonyella because of the finally agreed 12 hour shift roster and the relatively isolated location (45 minutes drive to Glenden, further to Moranbah given the existing roads).
7. Unlike the North Goonyella mine, the Moranbah North site is extremely close to an established community being 12 km from Moranbah. This proximity presents a number of difficulties for a FIFO operation with a "village" to accommodate the work force on site. An enclave of this kind is likely to be resented by Moranbah community which would perceive the Moranbah North work force as "outsiders" who were not contributing to the community. Moranbah's business community would be deprived of the extra demand that would be generated if the families of the Moranbah North work force were permanently domiciled in the town.
8. At this stage the implementation of a 12 hour shift is not contemplated at Moranbah North. A natural consequence of any other roster is that the work force will spend more days rostered on than rostered off. Therefore the commute option will not be attractive to potential employees, who will be required to be absent from their homes for extended periods of time.
9. Unions would be likely to have some concerns about a FIFO operation .

Summary of the FIFO approach to Queensland Coal Mines

Underground coal mines are very sensitive to the level of production per annum and production rates are the key to a successful coal mine. The North Goonyella operation hope to achieve high production rates by the retention of a highly skilled work force at the expense of the best perceived 6 by 9 hour shift roster and thus the FIFO approach to the servicing of the mine was adopted. The Moranbah North operation considers that utilisation of the best possible roster system to maximise work force productivity is the way to achievement of high production rates. The company has decided to domicile their Moranbah North work force near the mine site so that they can utilise a 21 day, 4 panel 7 day roster).

The two operations will be mining the same coal seam in relatively close proximity and over time it may be seen which operation has taken the most appropriate project development option for their underground coal mining operation.

Conclusions and Recommendations

The FIFO approach to the servicing of mining operations is well established in Australia. The overwhelming majority of FIFO operations remain pleased with their decision to adopt this approach. There is some evidence (although based only on a small amount of data from FIFO operations) that labour turn-over rates at some FIFO operations may be higher than those at town based mining operations. Several FIFO operations, however, have been successful in retaining a high percentage of their work force over the long term. These operations generally operate a symmetrical shift roster for mine employees and expend high capital sums to develop a high quality mine camp/hostel for employees at the mine site. Concern has been expressed that FIFO is a major barrier to professional employees participating in professional organisations such as the AusIMM. The North Goonyella coal operation, which was the first FIFO operation to be developed in Central Queensland, can be described as very successful in retaining its employees.

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References

Gillies ADS, Just G.D. and Hsin Wei Wu, 1991. The Success of Fly-in Fly-out Australian Mining Operations. World Gold 1991, Australasian Institute of Mining and Metallurgy Annual Conference, Melbourne.

Flannery, B., 1996. Pers. comm.

Stay, T., 1996. Pers. comm.

Torlach, J., 1996. Pers. comm.

Western Australian Department of Minerals and Energy, 1991. The demography of long distance commuting and regional communities (A regional perspective), Perth