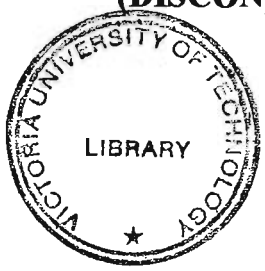
AN ANALYSIS OF SHIFT WORKING ROSTERS USED WITHIN THE AUSTRALIAN ARMY COMPONENT OF THE DEFENCE INTEGRATED SECURE COMMUNICATIONS NETWORK (DISCON)



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DECLARATION

I certify that this Thesis contains no material which has been accepted for the award of any other degree or diploma in any institute, college or university, and that, to the best of my knowledge and belief, it contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

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CHAPTER ONE

INTRODUCTION

Non standard working hours such as those experienced by rotational shift workers have a wide ranging impact upon job and roster satisfaction, performance, behaviour, sleep, quality of work and family life. The shift roster plays an important role in moderating the influence of non standard working hours on the individual and the group though it is well documented that shift work does affect everyone differently. Aspects of shift work that appear to be disadvantageous for many individuals can be considered to be beneficial by others depending upon the work circumstances and the needs of the individual and family.

Background to the Study

Australian studies conducted within the Brain-Behaviour Research Institute (B-BRI), La Trobe University (Knauth, 1989; Pattison, 1989; Singer, 1983, 1985 & 1989; Smith, 1982; and Wallace, 1983 & 1986) have demonstrated that shift roster design, the task at hand, and the individual's job, status, pay and social preferences are related to satisfaction with shift work. Many shift workers are bound to shift work by factors like monetary reward, home location, job experience, the nature of the job itself, qualifications and skills. Even if the shift worker wanted to give up shift working it may not be practical. There is a difference between the soldier and the civilian. Unlike their civilian counterparts, the soldier has no real choice when confronted with the prospect of shift working, that is, the alternative is neither

practical nor attractive in its nature. Service personnel have a service imperative and a commitment beyond that of the normal worker. They have a sense of duty that cannot be wavered. Yet, in the design and promulgation of the shift rosters they work under little regard is paid to research or study into shift working practices or to make those personnel aware of what they can do to decrease the effects of shift working on their working and non-working lives.

This study is concerned with shift work within a section of the Australian Defence environment - the Defence Integrated Secure Communications Network (DISCON) - Royal Australian Army Corps of Signals component, an area previously untouched by academic or other research. The significance of this study is that whilst it has focussed on a unique work environment the findings are not at variance to other shift working research.

The Australian Army, through units of the Royal Australian Corps of Signals, has the responsibility of managing and operating the Switching and Communications Centres throughout the states of Victoria and Queensland, and within the cities of Canberra and Sydney. Shift workers and the shift working rosters operating within these units are the focus of this study.

The purpose of this study is to compare the four shift working rosters operating within the four different Army units with DISCON and determine which one is most appropriate in terms of current roster design guidelines and shift worker preference.

DISCON was established to support the operations of the Australian Defence Force and Department of Defence for the rest of this century and beyond. DISCON is Defence's first secure, integrated communications system, and will be used for command and control of the Australian Defence Force as well as management and administration of the Defence Organisation. DISCON operates by means of interconnected switching centres which direct all incoming message traffic to its destination and link Defence establishments Australia-wide. DISCON Switching Centres serve a particular region through Communications Centres and decentralised communications terminals.

DISCON has brought with it new technology, new equipment and a range of new services to its subscribers. DISCON provides facilities for the passage of voice (secure and insecure telephone), facsimile, telegraph and electronic data and is expected to support the current range of tactical (field) external networks and individual tactical radio communication. There has also been a major change to the communications doctrine of providing pre-determined facilities, and subscribers no longer have to rely purely upon area or regional communications centres to service their communications needs of formal message traffic, facsimile and data transmission. Communications terminals have been decentralised to a large extent bringing them closer to the user - in some cases directly to them. Switching centres have also taken on the additional responsibility of providing advice to subscribers whilst communication centres are assisting with user education.

Shift Roster Management

Shift work and shift working management includes the design and operation of rosters which facilitate the staffing and successful completion of given tasks within the work place. Consistent satisfactory or superior performance will depend upon a wide range of factors including attitude, commitment to quality performance, esprit de corps, morale, individual and collective skill levels, experience, documented operating procedures and the way that the shift system supports these. The design of the shift roster can vary dramatically as factors relating to shift length, rotation and time on shift impact on shift workers.

Problems relating to shift work have, in the past, normally been solved in one of two ways. Firstly, the shift work schedule itself can be changed to compensate for the negative effects of shift work. This can mean changing the rotation from, for example, a slow rotation of three to four weeks to a faster one of less than two weeks, or by lengthening the hours of work whilst on a shift thereby compressing the work week into fewer days. Secondly, the work place itself can be changed by introducing new technology or management practices which negate the requirement for shift working.

Although there has been an introduction of new technology and a change in some of the management practices within the environment that the study is concerned with, this research focuses on an analysis of the three, four crew shift working rosters operating in the Melbourne, Sydney and Brisbane based Signal Corps units and the

five crew system operating in Canberra. These units are the total Army commitment to the tri-service DISCON responsibility.

In the past few years there has been much discussion (and argument for that matter) as to the merits of working shifts that differ to the traditional or standard eight hours per work day and in reducing the number of hours per week that a shift worker would work. In many cases the structure of Army shift working systems tends to reflect similar traditions of eight hour working rather than effective and efficient design. They have been developed to meet mathematical / objective (for example, hours of work, tasks to be completed) criteria within defined staffing constraints or establishment levels. The challenge of designing appropriate shift working systems is further questioned with the introduction of new technology and equipments, changes in the operating systems and procedures, as well as changes in roles and responsibilities. Little or no consideration appears to have been given to the absolute hours of work that the shift worker must endure, often greater than 45 to 50 hours per week, whilst working within the Army.

Statement of the Problem

The research problem is determining which shift working roster system will best facilitate the operation of the communication system 24 hours a day, 7 days a week, 52 weeks a year, year in and year out, whilst providing the shift worker with the highest degree of satisfaction at work and with good quality of work life. It is hypothesised that there is a positive relationship between shift roster design and individual satisfaction with, and preference for, particular shift rosters. Shift roster

design in this case refers to a number of predetermined guidelines or considerations that can be taken into account when preparing a shift working roster. Much study has been conducted in this area (Knauth & Rutenfranz, 1982; Smith, 1982; Knauth, 1989) resulting in a number of key elements which have become recognised as critical determinants of satisfaction with shift work.

Factors such as the implementation of change, that is, a change in technology and equipments, a change in operating procedures and work instructions, a change in work practices and focus, as well as potential changes in organisational structures of units working within the DISCON system including substantial downsizing will also play a part in the final selection. In the short term, numbers on the ground will influence the roster selection however, there is a longer term opportunity to remedy the situation.

The four Signal Corps units which are a part of this study approached the problem of manning the Switching and Communication Centres with personnel on shift rostering systems which tended to reflect their own unit practices of the past. Although they have experimented with other than their current shift working systems, the units tended to return to the status quo providing that the operational requirement was being met and existing staffing establishment levels were able to support the roster. There was also a pressure from shift workers to return to the roster they had a higher degree of comfort or familiarity with. Changes and trials of other shift working systems have generally been stimulated by the transfers of senior shift working staff from unit to unit (as part of the normal career posting, promotion and

progression that a service person undertakes) who have been in a position of authority to implement their preferred roster into the 'new' area, rather than a decision based upon planned activity.

Aim of Study

The aim of this study is to examine and compare the Army's three, four crew shift working rosters operating in Melbourne, Sydney and Brisbane and the five crew roster system operating in Canberra as part of DISCON with respect to the following:

a. Firstly, to review existing innovative approaches taken by units in the design of their shift working rosters.

b. Secondly, to determine which shift working roster is preferred by those working on shift within the system.

c. Thirdly, to determine which of the shift working rosters is designed most effectively in terms of established roster design criteria.

d. Finally to develop a better shift working roster model that can be implemented within DISCON.

The acceptability of shift work and the shift working systems were investigated by personal interview and mail survey. All shift workers involved in the study were

uniformed members of the Australian Army - Royal Australian Corps of Signals and were working on shift within the structure of a rotational shift working roster or had very recently returned to normal day work.

Limits of Study

This study is limited to the review and analysis of the four shift working rosters used by the four Army units located in Melbourne, Sydney, Brisbane and Canberra who form the total Army component of the DISCON system. Although the Royal Australian Navy and Royal Australian Air Force components of DISCON utilise both similar and dissimilar shift working rosters, they are not being taken into consideration due to security clearance and time constraints, however there is scope in this area for future study. The study is further limited by sampling only those shift workers who satisfied set criteria such as trade stream and minimum time on shift detailed in chapter three. This meant that only shift workers who were qualified and employed in the role of Operator Information Systems and who were working on shift at the time or had come off shift within one shift cycle length (maximum 28 days) were eligible to receive and complete the mail survey.

The opportunity to undertake quantitative research was restricted because of the lack of recorded data. Statistical information such as number of messages passed, errors made, security violations registered, messages lost, messages delivered outside time limits and messages retransmitted was not available because in the majority of cases the data was simply not collected. Where data was accumulated

the results were deemed to be confidential and as such were unavailable to the researcher.

Significance of Study

This comparative study into existing shift working systems was the first comprehensive review of the shift roster systems employed within the DISCON, the Corps and the Army in general. It provided an opportunity to examine current shift working practices in the light of both unit experience and current research. The findings could support a potential restructuring of unit establishments needed to compliment a common shift working roster that could meet the operational demands. This could also lead to the standardisation of shift working practices throughout the Army component of DISCON, and beyond into the Naval and Air Force components as well. In addition to this, the Corps of Signals has the opportunity of transferring this knowledge across to the tactical operations (field) arena.

Preview of Rest of Thesis

After reviewing the history and defining shift work, chapter 2 examines the previous research undertaken into shift work and shift working. The study reinforces the fact that such research is complex and enters into many areas such as psychology, sociology, ergonomics and biology. Notwithstanding this, the study looks at the organisational aspects of shift working including the introduction of roster design criteria as a roster development tool and the review of eight and twelve hour working. Factors relating to performance and individual satisfaction associated with the organisation of the job and shift roster are also reviewed. Points from this

review which have significance for the empirical enquiry are summarised and then supplemented by a statement of the conceptual basis for the study and hypothesis.

Chapter 3 examines the research method. A number of data collection methods were used including personal interview and mail survey.

Chapter 4 reviews the findings from the preliminary interviews and the two mail surveys with reference to the aims of the study. Firstly, the four individual shift roster systems under study are explained and innovative approaches taken by units in the design of their roster are analysed. Secondly, the mail survey results are reviewed to determine which shift roster is preferred. Thirdly, the levels of job satisfaction associated with each roster compared using the mail survey question results and an accepted measure - the Job Description Index (JDI). The four shift rosters are then analysed to determine which roster is designed most effectively in terms of the established roster design criteria

Chapter 5 offers discussion on the main findings. Shift worker preference and satisfaction with the shift roster are discussed leading into the effect that shift working has on performance.

Chapter 6 draws conclusions and leads to the development of a new shift working roster model.

CHAPTER TWO

REVIEW OF PREVIOUS RESEARCH

Shift work is now, and always has been, an integral part of society. The first shift workers were the sentries, gate-keepers and seafaring look-outs whose duties were crucial for the security and survival of their companions. Since that time and increasingly since the advent of the industrial revolution, shift work is very much an established labour pattern which affects a substantial proportion of the work force of any industrialised country. It has become a fact of life for many full-time and part-time workers, affecting profoundly the bodies, minds, relationships and involvement in community affairs of shift workers.

From the earliest of times shift working was recognised as a social problem. Mott et al. (1965, pp. 4-5) drew on the research of Bjerner, Holm and Swenssen (1948) when writing a background to the problems relating to shift work:

> Perhaps the first recorded instance of an organised concern with the issue is seen in the records of the European guilds of the thirteenth century. The principal complaint about night work at the time was that it reduced the efficiency of workers. At least one of the guilds, the rope makers, felt that the problem was serious enough to warrant a prohibition of night work. Others followed suit, and shift work more or less disappeared from the scene until the advent of the Industrial Revolution.

Ronan (1981, p. 3) confirmed that the pre industrial eighteenth century was characterised by the self-employed, independent farmer or craftsman who possessed a unique style of work and a special set of attitudes and values. They were

responsible for all managerial duties, including planning, organising, coordinating, and controlling. Motivation was high because they had a stake in the enterprise. Success meant survival whereas failure meant death, if not literally, then at least to their way of life. The farmer or craftsman had complete control over their workday and the autonomy to be able to consider and accommodate the various domains of their lives - work, family, and leisure activities. There was little separation between these domains, especially if family members were members of the enterprise.

Ronan contrasted the change that occurred with the coming of the industrial revolution. Not only were the talents and products of the craftsman in constant demand but they lost independence and autonomy and many had to endure extended hours of work or shift work itself to produce the required goods. The industrial revolution took away the independence and autonomy of many workers. Rapid industrial expansion in large cities combined with the movement of people from the land into the cities created a population which was highly dependent on an impersonal work organisation for its most basic needs. The management philosophy of the typical organisation embraced the idea that efficient production systems were based on the well coordinated activities of employees who performed fractionated, simply defined tasks in a highly structured and centralised organisation. Because the employee was viewed as part of the machinery of the organisation, there was no consideration of, or room for, variability in individual needs and expectations. Rigid, standardised work schedules were quite consistent with this philosophy of the work organisation and the employee's position in it.

Night work reappeared and became a fairly common practice when employers placed expensive machinery in factories prompting them to obtain a higher return from their investment by extending the number of hours worked each day. The ill effects of night work were again recognised and caused labour leaders to express concern. It did not take long for the legislators to introduce laws to regulate the hours of work of employees in many industries.

Night work became an agenda item in several International Labor Conferences held at the end of the 19 th and the beginning of the 20 th centuries. The Roubaix Conference of 1884, for instance, adopted a resolution petitioning for international legislation against shift work. Sixteen years later the Paris Conference of 1900 probed into some of the specific difficulties created by night work, such as the problem of sleeping and its relation to housing. The combined momentum of these two conferences provided an impetus toward the establishment of the International Association for Labor Protection (Mott et al., 1965, p. 5).

Shift work, nonetheless, is required in any modern, industrially developed country. It is prevalent in occupations and industries that are capital intensive and require continuous operation to be cost effective or that offer a product or service in demand late into the night or around the clock. People who work in mining, manufacture cars and machine parts, computers, textiles, paper, chemicals, rubber, plastics, and primary metals are usually shift workers. Shift work is not restricted to factories alone. Healthcare workers, laboratory technicians, medical orderlies, maintenance workers, physicians, nurses and emergency medical specialists, are

often involved in shift work as are fire fighters, police, correctional officers, security guards and military personnel are shift workers. The list can go on and on. Almost any occupation that can be thought of can, in many cases, have a shift working component.

Shift work may be used for four principal reasons:

a. In order to enable rendering service out of usual hours of work (which in most instances are limited to at the most eight hours per working day). Examples are power stations, hospitals, air traffic control and communications systems including those in defence environments.

b. In order to obtain more production in 24 hours than in the case of day work, that is, to increase production capacity. The objective can be to reduce throughput times. Use of shift work for this reason is often of a temporary nature. Examples are sugar factories and fruit canneries (during the 'season') and repair shipyards.

c. For technological reasons. If daily interruptions of production processes are inadmissible or at least burdensome. An example is high temperature furnaces in the metal industry or chemical processes within the petroleum industry.

d. For economical reasons. The higher the investment per work station the higher the economically optimum number of production hours per week will be required.

Shift work has been an essential factor in the development of the most successful industrialised economies. It has enabled the extended use of capital infrastructure, and has in effect provided the competitive edge to many enterprises operating in the international market place. It is a clearly desirable factor for industry in situations where a continuous flow process is used, high capital investment is required and short term technology is employed. Consequently, shift work must be recognised as an inevitable part of the job for a significant segment of any industrialised county's work force.

Defining Shift Work

Defining the term 'shift work' is not as easy as it appears because shift work means different things to different people. Shift work covers a wide variety of working time arrangements, including almost anything that is outside the normal working day (Ingram and Sloane, 1984, p. 168 cited in Blyton, 1985, pp. 61-62). Brown (1975, p. 231) took a somewhat similar broad approach by reminding readers that shift work covers a multitude of different working arrangements which are united only by what they are not: namely, arrangements which involve work performances during 'normal' working hours. The use of the word 'normal' in both these cases is in itself problematic, but both authors did intend taking a general societal perspective rather than one relating to particular occupational groups. Shift work has often been

compared to a four week, round the world whirlwind tour (Best, 1984, p. 1 and Coleman, 1989, p. 10).

Benjamin (1984, p. 74) defined shift work as "existing whenever employees are required to begin working at times other than 7:00 a.m. to 9:00 a.m. in the morning". Tasto et al., (1978, p. 154 cited in Coffey et al., 1988, p. 245) referred to the "three working shifts (days, evenings and nights) and to the rotating shift, which requires workers to switch back and forth among the three shifts". Coleman (1989, p. 14) added the notion of switching between shifts "rapidly every few days through to slowly every two or more weeks". Shift working can also refer to conditions as various as permanent night work (such as 9:00 p.m. to 6:00 a.m.) and other fixed shifts where an employee is assigned to the same day, evening, or night shift on a permanent basis, part-time evening shifts (6:00 p.m. to 10:00 p.m.), weekend shifts, split-shift schedules, oscillating shifts where employees alternate between day and night shifts only or where one shift is fixed and the others rotate, and relief shifts where workers fill in for fixed-shift employees.

The Australian Bureau of Statistics describes shift workers as those workers who worked two or more distinct periods of work within a 24 hour day between which employees were regularly rotated. Typically, the periods of time covered by the work shifts operating in any given establishment or workshop vary appreciably and often do not overlap with each other.

Defining shift work as a system where one worker replaces another on the same job with no break in the operation of machinery or equipment was the basis of a definition proposed by Pollet (1979, p. 1). Ingram and Sloane (1984, p. 168, cited in Blyton, 1985, pp. 61-62) reinforced this definition of workers replacing each other on the same job by adding the element of time, in this case, "within a 24 hour period".

Finn (1981, p. 31) reinforced the popular concept of changing work schedules where employees 'shift' their hours of work on some regular basis from daytime to evening or night-time. He went on to suggest that many researchers define shift work as employment in which two or more groups of employees work at different times of a 17-hour or 24-hour time span, including a so-called 'day' shift and that most discussions consider shift work to be any employment that regularly occurs between 7:00 p.m. and 7:00 a.m. This part of his definition does however distance itself from the broadly based theme that shift work occurs outside the norm of day work itself.

The shift worker is called upon to work different hours of the day, and to carry out activities at times which are often not synchronised with those of day workers. So there is a substantial proportion of the shift worker's hours which are out of phase with the normal community. As De La Mare and Walker suggest (1968, cited in Rowland, 1982, p. 2), "shift work comes to be regarded as something slightly abnormal, with hours of work which 'normal' people avoid".

Akerstedt (1990, p. 67) added the concept of teams passing work to each other referring to an arrangement of work hours which employs two or more teams (shifts) of workers in order to extend the hours of operation beyond that of conventional office hours. It has, however, become customary to apply the concept also to groups with more unstructured and irregular work hours and to groups with permanent night or evening work.

A universal definition such as 'all arrangements of working hours in place of or in addition to ordinary day work' is an appropriate general definition. As has been shown, this definition is widely supported. For the purposes of this study shift work is defined as a rotating, sequential program of work periods consisting of day, evening and night shifts of various types which vary according to length of cycle, number of crews or teams per shift system and hours of work per week.

Organisation of Shift Work and Roster Design

The majority of the early studies on the organisation of shift work were conducted in Europe. Drs P. Knauth and J. Rutenfranz (Institute of Occupational Medicine, Dortmund, West Germany) (1982) were considered to be leaders in the field, and their research was recognised throughout the world, particularly in the area of designing shift work roster systems based on physiological, psychological and social criteria. One of the aims of their studies into shift roster designs was to find ways of minimising the adverse effects of shift work on health and social life caused by the disruption of circadian rhythms.

As a result of their research, a set of roster design guidelines or considerations which have an important bearing on shift system design were produced. The primary considerations included the number of consecutive night shifts, the starting and finishing times of shifts, the duration of shift, the distribution of leisure time, the duration of shift cycle and the regularity of the shift system. These parameters still form an essential part of the guidelines or criteria for roster design today and are considered to be critical determinants of individual and group satisfaction with shift work.

Shift working has a number of inherent organisational problems. The most important of these lies in the selection of the shift roster itself. Which shift roster is most suitable? Research by Maurice (1975, pp. 98-108), Folkard and Monk (1980, pp. 263-72), Knauth and Rutenfranz (1982, pp. 337-67), and Wedderburn (1980, pp. 275-97) asserted that by taking organisational considerations into account some of the problems relating to shift work could be alleviated. Dr Peter Smith, Director of Occupational Research at the Applied Psychology Research Unit of the University of Bradford, England, supported the above assertion and made a number of critical recommendations which focussed on the design of shift working rosters and which should be incorporated in any shift working arrangement. He presented his findings during the 1982 B-BRI Shift Working Symposium, held at the La Trobe University, Melbourne.

According to Smith (1982, pp. 17-18), a shift roster should firstly be designed so that the number of consecutive nights is minimised. This design feature draws upon

research which has shown that the more nights worked in succession the greater the cumulative fatigue an individual experiences and motivation and performance levels fall below that of day working.

Secondly, in the design of a shift roster, the morning shift should not begin too early. Research has shown that individuals will cope more readily if the morning shift imitates as closely as possible normal day working so a start time of 6:00 to 9:00 a.m. would be considered to be reasonable. Shift workers will not go to bed earlier when they are on morning shift and if they cannot socialise whilst on afternoon and night shift they will do so when on morning shift. As a result they will be tired from having insufficient sleep prior to commencing work.

A third design guideline is that needs to be taken into account is that the shift change times should be flexible. Whilst desirable, this consideration is difficult to meet because it prompts the shift worker to determine when they will finish and start work. Although this will allow shift workers to take traffic, transport, family responsibilities and other personal needs into account it may not satisfy the work requirements of the operation at hand.

Another design feature is that the length of shift should also be related to the physical and mental load of the work. Each job is different. Some jobs are physically taxing, some mentally, some are both and some neither. The harder the total work load the less time should be spent on a particular shift. This may mean longer working hours for lighter jobs and less for heavier ones. In addition to this

guideline consideration should be given to decreasing the length of the night shift so that it is shorter than the day shift. If the night shift length presents a problem then it can be reduced. Hours worked may then be compensated by increasing the length of day and / or afternoon / evening shifts.

Smith recognised that individuals need time to recover from work and time to rest. When the hours of break between two shifts are short there is insufficient useful time for an individual to rest or recover. This can be of further concern when travel time between home and work is considerable. Overtime working can also present a problem when rest and recovery periods are reduced. A sixth guideline in roster design was therefore, that short intervals of time off between two shifts should be avoided.

In continuous shift rosters (that is, those involving weekend working) there should be provision for some free weekends off including at least two successive days off. Individuals need time off when others such as family and friends have time off work too. Time to go on outings, to shop and to do those activities which people like doing. Recovery time is also needed. Time to catch up with sleep and time to adjust to 'normal' daily routine. All too often in eight hour rotational shift rosters this guideline is ignored resulting in insufficient recovery time and poor recreational opportunities.

According to Smith (1982), the shift roster should also be regular. Shift workers should remain in the same team or crew and there should be no changing of rosters

to other shift systems. Overtime can present a particular problem because it often results in shift workers working double shifts or interferes with their rest and recreation.

Finally, shift workers should be able to plan ahead knowing fully well when they are required to work in the future. Rosters need to be predictable so as to minimise disruption to family and social life and to allow effective planning of future activities.

In some further research on roster design, Knauth (1989) added to the list of roster design considerations proposed by Smith. Knauth argued that in continuous shift systems a forward, phase delay rotation is preferred, that is, morning to afternoon to night shift allowing where possible twenty-four hours break between changes. In practice, for example a shift worker would work an afternoon shift from 3:00 p.m. to 11:00 p.m. and change to night shift the next calendar day at 11:00 p.m. Secondly, as individuals working on fixed shifts often find it easier to cope with abnormal working hours and can adjust accordingly, fixed shifts should be considered.

Another important consideration is that supervisors and managers should avoid calling shift workers in to work when they are not rostered on duty. This interferes with the shift workers rest and recreation period. In addition, where possible an allowance for napping should be made possible during the night shift. This helps alleviate tiredness and loss of concentration and enhances the ability to remain attentive for longer periods of time.

Shift workers should also be able to choose their roster particularly when a change is being considered. Giving shift workers a say in choosing their roster particularly when their decision requires a sound knowledge base promotes acceptance of and a commitment towards the new roster. Motivation to work can also improve. Shift work adds a degree of difficulty to organisational communication. It is important that employers and employees alike are aware of the different activity patterns of each crew. The internal and external communication system should be enhanced so that the shift worker remains aware of what is happening around them both at work and in the community at large.

To avoid the possibility of shift workers missing out on learning opportunities whilst they were on rest or sleeping, Knauth proposed that training should be conducted throughout the shift cycle, and not confined to day work only. He also noted that shift working offered additional prospects for taking on increased responsibilities and learning during those out of 'business hours' times when day working supervisors are not present. Both of these design guidelines were seen to contribute to the enhancement of trade knowledge and experience.

An allowance should also be made for transport and travel times. Peak traffic and at the other extreme lack of suitable after hours public transport may cause difficulties for some shift workers. Employers should ensure adequate transport services are or can be made available if necessary. Additional benefits such as extra recreational leave, increased pay and allowances or other conditions of service should be offered

as compensation for working non standard hours. Fringe benefits such as social, recreational and kitchen facilities at work should be provided.

Another guideline proposed by Knauth (1989) is that workloads should be structured such that task completion times can be chosen by the shift worker. A high degree of autonomy, particularly during the after hours periods when there is less supervision , needs to be encouraged. Supervisors may even have to adjust their supervisory style on morning and afternoon shifts to fit in with the more conventional attitudes present during day work. Not every one is able to cope with shift work so support services should be made available to assist those who are not coping or adjusting to the rigours of shift working.

Finally, in a shift roster design, consideration should be given to the length of the shift cycle. Longer shift cycles offer less flexibility in rotating staff in and out of the roster and make it more difficult for shift workers to plan their social engagements in advance. The regularity of social contacts in quickly rotating rosters is greater than weekly rotating ones. In a quickly rotating roster, say two morning, two afternoon and two night shifts, the shift worker has at least two nights a week free.

The roster design planning guidelines and considerations detailed above will be referred to as shift roster design criteria throughout the rest of the paper.

During a series of seminars featuring shift work at the Macquarie University in 1987 and 1988 and with the Australian Institute of Management in Melbourne during

1988, Knauth stated that "there is no one best shift system which can be recommended for all kinds of work. On the contrary, the roster must be tailored to the demands of the individual job". Knauth reinforced the usage of roster design criteria as development tools for shift roster systems. These recommendations have not been disputed in subsequent studies and in fact have formed the foundations of shift roster planning in this country. Whilst it is recognised that it is difficult to satisfy all of the roster design criteria, the more criteria that are taken into consideration, the greater the potential reduction in the negative effects of night and shift work.

It is interesting to note that much of the (earlier) research was based upon eight hour shift roster systems which followed the traditional eight hour working day and forty hour working weeks. Although eight hour shifts are the most common, the length of individual shifts do vary. Nowadays, this poses a different problem because the standard work week is somewhat shorter. Up until 1986 it was still much less usual to find rosters of twelve hour day, twelve hour night, shifts (Wallace, 1986, p. 5). This was certainly not the case overseas where, for example, a Hoechst plant had been operating a twelve hour shift system for some forty years prior to 1986.

The Brain-Behaviour Research Institute (B-BRI) of La Trobe University has been responsible for much of the detailed research conducted on shift working and shift work in Australia. Their research and consultative practice raised the level of understanding of shift working and its inherent problems within the working

community at large resulting in improvements in the quality of working and non-working life for shift workers and their families.

Until 1982, research on shift work in Australia was fairly sparse but nevertheless, that research supported the findings of the studies undertaken overseas. The B-BRI held a seminar entitled 'Work Effectiveness on Shift and Night Work' on the 28 April 1982, the first of many symposiums, to address shift working and it was in this forum that the efforts of some of the Australian researchers were brought to public attention. The results and the subsequent reporting was based upon physiological, sociological and biological research. It is not my purpose to summarise this work suffice to say that many of the conclusions made have been followed up and supported by the B-BRI and other Australian researchers.

The Reduction of Working Hours

The reduction of working hours from 40 to 39 or less a week has had a major impact on those work places where continuous processes and shift work predominates. In the past most twenty-four hour working companies would employ four crew working ie. four sets or teams of shift workers which would alternate throughout the twenty-four hour cycle, with shift workers working on average 42 hours a week. This was quite logical because there are 168 hours in a week and four crews sharing the time available would work the equivalent of a 40 hour week plus two hours rostered overtime. Once working hours were reduced, new pressures were placed on existing shift systems. The choice was to increase rostered overtime, increase the number of shift workers, increase the number of shift crews or a combination of

those choices. Five crew working became popular because employees were required to only work 33.6 hours. This also gave the shift worker the added benefit of more useable time off.

Another way of providing employees with more useable time off was to increase working time to twelve hour shifts. This seemed popular with employees, but some management groups are less enthusiastic because they believe that longer shifts create additional fatigue and that productivity might decrease. Evans and Bell (1987) and others argued that the success of twelve hour shift working would depend at least to some extent on the nature of the work. If it is very arduous, mentally or physically, then twelve hour shifts may not be a viable alternative at all.

Assessment of Twelve Hour Shift Rosters

In assessing whether or not a twelve hour roster can be introduced, there are many factors which need to be considered. Of these factors, many fall into physiological, psychological, sociological or biological areas of concern. Notwithstanding this, or the overall premise that no shift working system is ideal, some twelve hour rosters may be acceptable, providing that they meet the established roster design criteria in the same way an eight hour roster would.

Meredith Wallace (1989, p. 55) suggests that some of the organisational problems related to twelve hour shifts are associated with their initial implementation. These are related to the method of payment for hours worked (pay averaging is necessary), arrangements for sick leave and the manpower plan for coverage of absenteeism and

overtime. As in eight hour rosters, shift workers themselves should have a primary role in the design and implementation of the roster bearing in mind that there is no 'one best' roster as each individual and each place of work has its own specific needs and demands.

There has been a concern of increased public risk if twelve hour shifts are worked at locations where there are large quantities of dangerous materials, such as nuclear power electricity generating stations. Kelly and Schneider (1982, p. 381) saw the impact on public safety as being perhaps the most important criteria for review prior to changing to twelve hour shifts in a Canadian nuclear powered electricity generating plant. The task group they were working with determined that shift crew error was a major cause of past faults and that a predicted error increase of 80% to 180% was applicable in this particular case. Since the margin between target and actual performance was very small for some of the critical tasks, 12 hour shifts proved to be unacceptable in this case.

The B-BRI has conducted research into shiftwork rosters for a number of years and have advised on, and installed, twelve hour rosters in a number of industries and service organisations including manufacturing, the power and oil industries, public transport, communications, computer services and nursing. The B-BRI (Wallace, 1986, p. 8) "determined that a change from the 8 hour to the 12 hour shift system produced no consistent changes in the test results and concluded from the physiological point of view, that 12 hour shifts did not represent a harmful overload, at least in the short term". They did however recommend long term follow up

studies be undertaken to assess the health of these groups of workers. The overriding concern with a twelve hour roster is that the job which is being performed over the extended hours must not take an unacceptable toll on the worker's health, nor must his or her performance deteriorate over the twelve hours to an unacceptable level.

An early concern, this time expressed by Australian unions, and one which is very much philosophically based, was that the twelve hour roster is against the spirit of the hard fought and won condition of the eight hour day. On the surface, unions will not accept what appears to be a deterioration of conditions of work. Added to this is the worry of coverage - can a worker covering an absentee work for longer than 12 hours? A worker might have been able to manage a double shift of 16 hours, but 24 hours is certainly out of the question. Nothing is published on how this predicament is handled. One can only assume that standby, casual or emergency rostering is utilised rather than double shifting. Despite reservations by unions, Workforce New South Wales (23 April 90, 777, suppl. 1) suggested that twelve hour shifts were likely to be more widespread in the future and that longer shifts were being included more frequently in award restructuring and in enterprise bargaining.

In 1988 the Australian Council of Trade Unions (ACTU) and Victorian Trades Hall Council (VTHC) adopted a Code of Conduct on Twelve Hour Shiftwork. In adopting the Code they recognised that shiftwork was a potential occupational

health and safety hazard and offered a constructive and practical framework for the development of safe, healthy shift rosters.

The key features of the Code of Conduct was notified in 1988 in the Health and Safety Bulletin, Vol. 58 in an article titled 'ACTU Adopts 12 Hour Shiftwork Code'. The key features are as follows:

a. Recognition of the health risks of shiftwork.

b. Distinction between leisure time and recuperation time.

c. No more than 2 night shifts should be worked in succession.

d. Health supervision and services should be provided to shift workers.

e. 12 Hour Shifts should be permitted under certain circumstances.

f. 12 Hour Shifts should be introduced on a trial basis for twelve months.

g. Introduction of 12 Hour Shifts involving bonus/incentive schemes or similar are opposed.

h. 12 Hour Shiftwork Rosters must be developed in consultation with workers through their unions.

Many of the shift roster design criteria detailed previously were also included in the Code.

The disappointing aspect of this literature survey is the fact that whilst much is going on with regard to the trial and implementation of twelve hour shift working rosters, there has been no regular reporting of the results.

Factors Relating to Performance

Shift work requires a particular pattern of living that directly affects the behaviour of the worker at work and in his family and social life. Some of the earliest studies of shift work were concerned with the effects on worker's health, as individuals circadian rhythms were at odds with those controlling the biological functions of eating and sleeping. Methodological difficulties may well have contributed to contradictory results but there was a gradual agreement that shift work did create or contribute to health problems.

Akerstedt (1990), Carpentier and Cazamian (1977), Monk and Folkard (1985) are several of the many researchers who have documented shift work related problems such as fatigue, industrial accidents and sleep disturbances. Penn and Bootzin (1990) saw the stress of shift work resulting in health problems such as weight gain, gastrointestinal disorders and increased length of illness. Maurice (1975, p. 36) went as far as suggesting that:

> the effects of shift worker's health were investigated before its repercussions on family and social life because shift work was adopted for economic reasons. It was necessary to measure the effects of shift work on all of the factors of production, and the worker was regarded as such a factor. The

> study of labour output, industrial accidents or absenteeism thus necessarily involved the study of the pathological effects of this way of organising work.

The ability to perform work is affected by other factors too. Length of the work period, the task at hand, physical conditioning, the time of work and the work environment, all have an effect. Bonnet (1990, p. 261) suggests that a five to ten per cent decline in capacity for work in nocturnal work periods as compared to day time work periods can be expected. This decreased capacity would dissipate if workers maintained a consistent sleep-wake routine for 8-16 days after moving to a new shift. The ability to perform work also declines as the length of the work period increases but depending upon individual tasks.

At about 4:00 a.m. on Wednesday the 28th March 1978, a series of events took place in a control room. This series of events was soon to become world news. The 'Three Mile Island' incident occurred because of human error. The workers involved were weekly rotating shift workers who were half way through their night shift. The errors involved may have jeopardised the safety of not only the shift workers themselves, but also of thousands of people in surrounding communities (Monk and Folkard, 1985, pp. 239-40). Not all incidents which occur on shift will have the same impact but it is important to note that incidents can and will occur.

Trying to assess the extent to which shift work affects a worker's productivity is a challenging and complex task. Task or work demands play an important part in the assessment however time of day, sleep deprivation, health, motivation and the ability to adjust to new routine all have an effect on performance.

The measurement of productivity and performance in any enterprise more often depends upon the nature of the enterprise and the products that it produces. The number of tonnes of steel produced by a steel mill in a given time can be readily measured. The number of cars assembled by an automobile manufacturer during a working shift can easily be measured. Any improvement in the production process will be reflected in the output results.

In industry, the performance of both human beings and machine is a very important topic of discussion. Under normal circumstances, the performance of the machine usually remains uniform in all shifts. But the performance of humans working with the machine varies during the day and night with various conditions and rhythms of alertness and fatigue. Sen et al. (1982, p. 57) wrote that it was imperative that the nature of fluctuations of physical and mental work capacity of humans be explored so that the time of rest and work, considering fatigue and alertness etcetera, be wisely scheduled.

One of the first questions studied on the effects of shift work was on the worker's output and productivity. This type of investigation was found to present a number of difficulties. A comparison of the output of workers on shift work with those of workers on a normal routine gives rise to certain methodological difficulties because two different populations are involved. This is the result of not only the recruitment and selection process when the workers are employed but also of a self-selection process by the workers themselves when they choose the job. Even if the study is carried out in the same area of operation, or even in a single undertaking, the work

done will rarely be comparable, not only because of the content of the job, but above all because the conditions under which it is performed will be different. It is therefore necessary, when possible, to compare different shifts (morning, afternoon and night) within a given system of shift rotation, or in other words, to study the difference in output between shifts. In the case of rotational shifts it may be necessary to take into account the position of each shift within the cycle of rotation if quantitative measures are required.

There are also many enterprises where there are no readily identifiable production outcomes or where the production results are inherently inconsistent across the day, evening and night shifts and from day-to-day. Productivity and performance measurement in the DISCON environment falls into this class of productivity. DISCON is operational 24 hours a day, 7 days a week, 365 days a year, year in - year out. The system is managed and operated by shift workers who work in a variety of shift rosters in an environment where the workload is not consistent throughout the working day or within each centre of operation. There are peaks and troughs relating to the input times of formal message traffic by subscribers to the system. Experience shows that the busiest times of work tend to be from mid morning through to early evening but these can change quickly according to needs of Defence. In times of emergency, rostered planned shift working is often dispensed with and longer working hours introduced.

The use of purely specific output indicators such as numbers of messages passed and error rates have been used to measure productivity and performance in individual

locations, however as a comparative standard these have not been useful because of the vast inconsistency of work load across the network and the methodological difficulties raised earlier in this section. Cost indicators associated with traffic flow, for example reception, processing, transmission, receipt and delivery, again provide no real indication of productivity.

Human resource and labour indicators such as absenteeism, labour turnover and time lost to industrial action again have no place - Army personnel have particular conditions of service as well as rules and regulations to follow. Loss of work time due to work place injury and accidents can be assessed, however, one must be careful to ensure that the time actually lost was caused by an event directly related to the principle task. Clearly the majority of work related injuries occurring within the area of this study are caused during times of physical and recreational training and sporting activities. The maintenance of a high level of physical fitness is a necessary part of service life and there is an expectation that some lost time for non work related injuries will occur. Records, however, of lost work time accidents and injuries tend to be kept at higher levels and are not readily available to units under study.

Quality indicators such as the level of customer complaints as a measure of customer satisfaction, message delivery time registers, numbers of errors, readability of messages, retransmits, lost messages and security violations are recorded in operational log books but are not available for review. The personal interviews conducted with supervisors suggested that such statistics are generally retrieved and

acted upon during the regular work related coaching and counselling sessions of subordinates.

Employee satisfaction indicators such as the level of morale, attitude, training, autonomy and levels of responsibility are gauged once again by supervisors and form part of the regular individual performance appraisal process. The shift roster system will play an important role in supporting suitable levels of individual and group satisfaction, morale and attitude as well as contributing to levels of fatigue.

Enhancing Alertness and Performance

Penn and Bootzin (1990) suggested that there were several methods which can be used to enhance the alertness and improve the performance of shift workers and categorised them into two broad areas. Firstly, behavioural and cognitive interventions that produce immediate alerting effects so that performance at work can be enhanced. Secondly, interventions directed at long-term remediation to counteract the deleterious effects of shift work in major aspects of the employee's life. Their suggestions were drawn from industrial performance studies, stress management literature, vigilance studies, sleep studies and broader psychological literature and included rest periods, introducing variation, complexity and interest value in the work, self-pacing of tasks, feedback and knowledge of results, incentives, sensory and kinaesthetic stimulation and physiological regulation. These will be addressed in turn:

a. **Rest Periods**. The effects of rest breaks have been the focus of much research. Rest pauses aid the maintenance of efficiency, produce benefits in mood and return lasting increases in overall productivity even though less time is devoted to working. Five to ten minute breaks every half to one hour appears suitable for most situations. For this to occur increased levels of staffing are required.

b. **Variation, Complexity and Interest Value of Work**. Variation in activity and adjusting the complexity levels and interest value of the work will enhance productivity. Variety reduces boredom and assists concentration.

c. **Self-Pacing of Work**. There is some evidence that self-pacing of work will reduce performance loss over time particularly for very demanding tasks. This may result in the worker being able to optimise their individual energy resources and rhythms by adjusting their output according to their expectations of the task and knowledge of their own capabilities.

d. **Feedback / Knowledge of Results**. Knowledge of results will not only reduce the effects of sleep deprivation but enhance performance and reduce losses in alertness over time.

e. **Incentives**. In many cases greater financial rewards or time off in lieu are offered to shift workers and these become the major reasons or motivation

for working within a shift system. The value of the incentive will depend on individual needs.

f. **Sensory and Kinaesthetic Stimulation**. Short term enhancement of alertness and performance can be obtained by the use of sensory and kinaesthetic stimulation such as noise and music, bright lights, exercise and movement.

g. **Physiological Regulation**. Food and drink can produce an enhancement of alertness and performance. High protein foods may help to sustain arousal whilst high carbohydrate foods may produce drowsiness.

Sleep

One of the most dramatic effects of shift work is disturbed sleep. A number of survey studies have indicated that shift workers have difficulties at maintaining sleep after the night shift and initiating sleep before the morning shift (Akerstedt, 1990, p. 68). Results indicate that sleep length on the night and morning shifts of rotating shift workers is reduced by 1 to 4 hours. Research has indicated that shift workers report more fatigue than day workers. Usually the fatigue is particularly widespread on the night shift, hardly appears on the afternoon shift, and is intermediate on the morning shift.

If sleepiness or fatigue is as widespread and as dramatic as has been demonstrated, one would expect to see pronounced effects on performance, and consequently on

output and safety. Akerstedt (1990) reports on a number of studies which show such effects on performance. A earlier study by Bjerner et al. (1955) in the Swedish gas industry showed that errors in meter readings over a period of 20 years had a pronounced peak on the night shift. Similarly Browne (1949) demonstrated that telephone operators connected calls at a considerably slower pace at night. Hildebrandt et al. (1974) found that locomotive engineers failed to operate their alerting safety device more often at night than during the day. Although disagreement and lack of evidence predominate regarding the effects of evening and night work on employee safety, there are sound physiological grounds for presuming an increased rate of accidents at night based upon laboratory studies of efficiency and errors relating to circadian rhythms. Most other studies of performance have used laboratory types of tests and demonstrated reduced reaction time and poorer mental arithmetic on the night shift.

If sleepiness is severe enough then a shift worker's interaction with the working environment will cease, and, if this interaction coincides with a critical need for action, an accident or incident may ensue. British transport accident data (Harris, 1977; Hamelin, 1981 and 1987) supports this view with single vehicle accidents occurring mostly at night and early morning.

The Future of Shift Work

Studies of shift work and shift working will continue in Australia and overseas whilst the working conditions of shift workers are disadvantageous in comparison with those working normal hours. Work and the organisation of work is changing as new

technology is introduced, hours of work reduce and quality and performance management issues come to the forefront. The human cost of shift work however, is still largely borne by the workers themselves, who have to cope with two different, often contradictory, time structures and whilst this is so, shift working demands more attention.

There are a number of methods that can be used to reduce the impact of shift working on those who are party to it:

a. The volume of shift working can be decreased or its practice restricted to those sectors where it is justified for social reasons, because society needs it to function effectively or for technological reasons.

b. The number of actual working hours can be reduced. Modifying rotation patterns does little to relieve the problem. An increase in the number of crews, for example, from a four crew roster to a five crew one, will definitely improve working conditions and priority should therefore be given to this solution.

All too often the above are not or cannot be considered.

Summary

There has been much evidence presented to suggest that shift working can have detrimental effects on health, that shift work impacts on individual and organisational

performance as well as interfering with the enjoyment of social and family life. The problems relating to shift work have been a part of the working environment for a long time. It is well known that few shift workers like or have a preference towards shift work, many dislike it and most tend to tolerate or live with it. They do not like it because of a number of reasons including the undesirable work times - nights and weekends, the rotation from one shift schedule to another causing upsets to physiological and psychological patterns, and the difficulty of fostering social relationships with family and friends.

Organisation of Shift Work and Roster Design. Many researchers including Knauth (1982 and 1989) and Smith (1982) have determined that some of the organisational problems related to shift working can be reduced with the application of the roster design criteria to the shift roster itself. Primary considerations included the number of consecutive night shifts, the starting and finishing times of shifts, the duration of the shift, the distribution of leisure or off shift time, the duration of the shift cycle and the regularity of the shift system. Shift rosters prepared with these considerations or guidelines in mind reduce the number of inherent organisational problems and may promote, as hypothesised, a positive relationship between shift roster design and individual satisfaction with, and preference for, particular shift rosters.

Changes to Working Hours. The reduction of average weekly working hours and moves towards twelve hour shift working have had a major impact on the design and development of shift working rosters and have encouraged the readdressal of the

organisational aspects of shift working and roster preparation. It will be important to review the outcomes of future research in this area and apply such to shift roster design.

Performance. It has been widely recognised that shift working has a direct impact on the shift worker at work and in their family and social life. The ability to perform work can be affected by the design of the shift roster as well as by a number of other factors including the task, environment and physical conditioning. Assessing the extent to which shift work affects a worker's productivity is a challenging and complex task without the added variables of health, sleep deprivation, motivation and the ability to adjust to a new working routine. Certain measures such as rest periods and varying the complexity and interest value of the work can be applied to shift working situations to enhance alertness and performance. The shift roster itself will also play an important role in supporting levels of individual and group satisfaction, morale and attitude and can contribute positively to improved performance. Applying the roster design criteria to the individual shift rosters may also promote the change or redesign of shift rosters and as such may contribute to improved individual satisfaction with not only the roster but with quality of working life.

CHAPTER THREE

RESEARCH METHOD

There are many methods available for collecting data and the choice between these depends on a number of factors such as the nature of the questions, response rates, resources available, time and the sampling frame. In this case a number of methods were utilised. Firstly, structured preliminary interviews were conducted to facilitate an in depth understanding of the shift rosters in use. Secondly, a mail survey questionnaire was used to explore shift roster preference, satisfaction and several other potential variables. Thirdly, a follow-up mail survey questionnaire was used to clarify some of the data obtained in the original mail survey document.

a. **Nature of the questions**. Given the nature of the questions, and in particular the depth and complexity of the topics being covered, it was decided to collect the required data by a number of methods. Initially a set of questions were prepared for a series of structured interviews (see Appendix 1). The results from these preliminary interviews facilitated a clearer understanding of the shift working rosters in each of the four locations and assisted in the preparation of a detailed mail survey questionnaire. The interviews also enabled a close working relationship to be established with the four units and shift working staff which would prove to have a positive impact on the response rates. The mail survey questionnaire (see Appendix 2) facilitated the collection of much useful data and was the cornerstone of the study. As a

result of an apparent weakness in the mail survey questionnaire, a follow-up mail survey questionnaire (see Appendix 3) was developed and used to clarify or put into perspective some of the data collected from the initial mail survey.

b. **Response rates**. The response rate to the initial mail survey was 100% of those who satisfied the random selection criteria in three of the four units and 95% in the other (one survey document was mislaid). A total of 72 mail survey documents were distributed and 71 were returned. Of those returned a clear majority were completed in total detail with few responses being left blank. Sixty follow-up mail survey documents were distributed throughout the four units and all were returned complete. The reduction in numbers, from 72 to 60 completed survey documents, can be attributed to substantial downsizing of shift crews across the four units. There was also a need to gain data from non shift workers and compare such with shift worker responses.

In most cases the quality and reliability of survey data can be affected by the degree of response to a survey and it is also rare to achieve a 100% response rate. In this case a high rate of return was expected because of the support and commitment shown by the senior officers, troop commanders, shift and non shift supervisors and shift workers towards the study. The preliminary interviews reinforced the importance of the study, not only to myself as a researcher, but to those involved as well. The commitment offered by the surveyed units to facilitate the distribution and collection of the surveys /

questionnaires was exceptional. Each unit appointed a Project Officer whose responsibility was to ensure that over the two week period of the mail survey all members of staff who satisfied the selection criteria and who were present on duty at the time completed the survey.

Despite the depth of support provided by the Unit Project Officers and by the respondents themselves, independence of responses was achieved. Anonymity and confidentiality was assured throughout the process although some respondents insisted on writing their name on the mail survey document. When this occurred, the front cover (the place where the name was written) was removed by the Unit Project Officer or myself.

c. **Resources**. Resource support in terms of telephone access, facsimile, photocopying and defence mail was provided by the Melbourne based unit. All four units appointed a Project Officers whose responsibilities included the distribution of mail survey documents and their collection once they were completed. This support proved invaluable during the data collection phase of the study.

d. **Sampling frame**. All respondents to the preliminary interviews and the initial and follow-up mail surveys were uniformed members of the Royal Australian Corps of Signals. They had a common base trade qualification, Operator Information System, and were employed in a similar operation and environment albeit in four different locations. The worn rank varied from

Signalman (base rank) through Lance-Corporal, Corporal, Sergeant, Staff Sergeant and Warrant Officer, though in the case of the interviews one junior officer, a Lieutenant, was interviewed. The more senior in rank the more likely the respondent was acting in a supervisory capacity.

The selection criteria for the interviews was that the interviewee had to have had some experience in working within the unit shift system or supervising those who did. Those interviewed were selected on an availability basis, ensuring, however that three supervisors and three shift workers were interviewed in each of the four units. The initial mail survey respondents were all currently working on a rotational 4 or 5 crew shift system within their unit or had just returned to day working within one shift cycle (a maximum of 28 days). Qualified shift workers who were on leave at the time of administering the mail survey and those who had been employed on day work for a period in excess of 28 days were excluded from the survey. There was an even mix of gender: 36 male and 35 female and at the time thirty-six were employed on 4 crew shift working, sixteen on 5 crew and nineteen had just returned to day work.

The time delay between the administration of the mail survey document, subsequent analysis and the recognition of several weaknesses in the data collected resulted in the follow-up mail survey not being able to be administered to the same sample. During this period of time substantial downsizing of numbers of shift working positions had occurred as well as a

number of postings and promotions of staff members out of the units concerned. The sample of 30 shift worker and 30 non shift worker Operator Information System qualified soldiers who took part in the follow-up mail survey were selected from two of the four units representative of the two different shift roster systems. The 30 soldiers surveyed in each of the two units consisted of the first 15 shift and 15 non shift workers who were rostered for duty on a prescribed day.

Table 1, shown on the following page, summarises the sampling details for the preliminary interviews, mail survey and follow-up mail survey. Shift workers were defined as those who were currently employed on a rotational four or five crew shift roster system. Day workers were defined as those who had recently returned from rostered shift work to day work within one shift cycle. Non shift workers were defined as those scheduled to work during the day generally from Monday to Friday.

Table 1 - Sampling Details.

Unit	Shift System	Preliminary Interviews	Mail Survey	Follow-Up Survey
6 Signal Regiment (Melbourne)	4 Crew	3 Shift Workers 3 Supervisors	14 Shift Workers 8 Day Workers	15 Shift Workers 15 Non Shift Workers
4 Signal Regiment (Brisbane)	4 Crew	3 Shift Workers 3 Shift Leaders	14 Shift Workers 6 Day Workers*	
134 Signal Squadron (Sydney)	4 Crew	3 Shift Workers 3 Shift Leaders	8 Shift Workers 4 Day Workers	
135 Signal Squadron (Canberra)	5 Crew	3 Shift Workers 3 Shift Leaders	16 Shift Workers 2 Day Workers	15 Shift Workers 15 Non Shift Workers
Totals		12 Shift Workers 12 Shift Leaders 24 Interviewees	52 Shift Workers 20 Day Workers* 72 Mail Surveys*	30 Shift Workers 30 Non Shift Workers 60 Mail Surveys

* Note: 1 Day Worker completed Survey was mislaid in Brisbane.

Structured Preliminary Interview

The structured preliminary interviews were designed to facilitate an in depth understanding of the shift working rosters in use and the reasoning behind their development or selection. The interviews would also engender support for the study in each of the four locations. The interview questionnaire was piloted in Melbourne to test its suitability by conducting a series of group discussions with senior staff members of 6 Signal Regiment. A copy of this questionnaire titled 'Supervisor / Shift Leader Interview' is enclosed as Appendix 1 to this study.

The interviews were conducted over a three week period with 3 shift supervisors and 3 shift leaders in the four different Regiments and Squadrons. A total of 24 individuals (6 in each unit) were interviewed with each session lasting between 45 and 90 minutes. On the basis of the detailed interviews with supervisors and shift leaders, a thorough understanding was gained on how the roster design criteria impacted on or influenced the design of the shift system. Unit commanders were notified of the results through the medium of departure interviews and post analysis telephone conferences.

This particular aspect of the overall strategy was considered to be essential because it facilitated getting to the root or essence of the shift rostering practice. Being the first study of this type there was also a need to develop a trusting relationship with potential respondents, reinforce the credibility of the study and to gain commitment from the four units.

The four shift roster systems subject to this study were then contrasted against the established roster design criteria criteria using a simple scale of 1 point being given if the criteria was satisfied and 0 points for non satisfaction. The aim of this comparison was to determine whether the preferred shift roster satisfied more of the established design criteria.

Mail Survey Document

The structured preliminary interviews underpinned the development of the Mail Survey document (see Appendix 2). The mail survey sought to explore a number of issues:

a. Firstly, to determine which shift working roster is preferred by those working on shift within DISCON.

b. Secondly, to compare the level of satisfaction of shift workers between four crew and five crew shift workers.

c. Thirdly, to contrast any differences in perception between four and five crew with regards to performance, development of skills and levels of supervision and control.

The Mail Survey document was directed at all Operator Information System qualified soldiers who had been engaged in shift work for the last twelve months. As a result, the mail survey sample was diverse. It included both sexes, a wide range of rank, experience, length of service, depth of knowledge and time on shift.

Individual question results were cross tabulated to test the relationship that gender, work pattern, supervisory responsibility and length of time on shift would have on roster preference and satisfaction with the job and shift roster. Detailed comparative

tables are not included within this study but are available in SPSS format from the author.

The first eleven questions were designed to provide general information about the respondents and to organise the cross tabulations. The next eight, questions twelve to nineteen, asked respondents to indicate preferences relating to their like or dislike for shift working. Questions 20 through to 47 asked the respondent to indicate how much they agreed or disagreed with a given statement by marking one element within the scale of strongly agree, agree, did not know, disagree and strongly disagree. This scale was designed to give a general indication of agreement or disagreement rather than a measured range and as such the results will be presented and discussed within the framework of a three part scale of agreement, did not know and disagreement.

A number of questions throughout the mail survey document sought to determine respondent preference for working on shift. The questions sought to measure preference for working shift work, the preferred shift roster and preferred part of the rotational cycle (day, evening or night shift).

The four shift rosters were assessed in terms of the established roster design criteria, preference, job and personal satisfaction. To determine and compare the levels of job satisfaction within each shift roster system, an established and proven measure was sought. The Job Description Index (JDI) (O'Brien et al., 1977) was adapted to meet the requirement and was included as Question 49 within the body of the Mail

Survey. The JDI normally addresses five aspects of the job - the work itself, immediate supervision, promotion, co-workers and pay. The respondents are given a range of supportive and non-supportive words within each category and are asked to choose the response which reflects their own circumstances.

The JDI would score a point for each match with the response shown by the key where Y = a yes response and N = a no response. A non match or blank scores no points. The higher the score within each section and the higher the total score would indicate a higher level of job satisfaction than those with lower scores. The maximum possible scores for 'work', 'supervision' and 'co-workers' was eighteen points whilst 'promotion' was nine. Pay was not considered to be relevant as all respondents were engaged under common pay and conditions arrangements. This index is a reliable measure of job satisfaction and has been used extensively in Australia by O'Brien, Bentley and Sweeney in the Health Industry.

Prior to distribution the Mail Survey document was tested in Melbourne by a group of four non shift working Supervisors and four Shift Leaders engaged within the DISCON system. Some minor modifications were made to the questionnaire as a result of the trial.

Sufficient time was allowed for the mail surveys to be completed during the shift cycle. Respondents were able to participate whilst they were physically on shift and were not brought in especially for the task. A copy of the Mail Survey documentation is enclosed as Appendix 2.

Follow-up Mail Survey

In addition to the data obtained from the mail survey, it was determined that there was a requirement to evaluate how important shift workers and non shift workers rated the various roster design criteria. Ideally the additional questions should have formed part of the original Mail Survey document but the issue or concern was not identified until after the initial mail survey was distributed. As three of the four units functioned with similar four crew shift working rosters, the follow-up mail surveys were forwarded for completion to one representative four crew shift roster unit and the five crew one. Fifteen shift workers and 15 non shift workers (non shift worker was defined as a person who had not been on shift work for at least 6 months) were selected on the basis of who was rostered for duty first on a prescribed day by Unit Project Officers in the two units to participate. Table 1 details the sampling details. The follow-up mail survey document is enclosed as Appendix 3.

The rating scale used gave 3 points to those criteria considered very important, 2 points for important criteria and 1 point for those considered not important. The maximum score possible is 90 points (30 respondents X 3 points) for both shift and non shift workers. The minimum score possible is 30 points (30 respondents X 1 point).

This comparison was important in determining whether the roster design criteria had relevance to those shift and non shift workers associated with the shift roster systems under study.

Although respondents were asked to rate all twenty of the Roster Design Criteria, this study will only review the three most or least important rated criteria. The rationale for this is to explore the main issues only at this time.

The resultant information obtained enabled the author to rate each of the twenty roster design criteria in turn against the design of the four individual shift rosters. Where one point was given the particular shift roster substantially satisfied the requirements of the criteria. For example, with the first criterion, 'there should be few nights in succession', the three 4 crew shift rosters each had seven night shifts in succession and thus did not satisfy the requirements and did not score a point. The five crew shift roster system only had three night shifts in succession and therefore scored one point.

Mail Survey Management

The operational aspects of the mail surveys required a great deal of planning and coordination. This task was aided by the provision of photocopying, telephone, conference and service mailing facilities by the respective sample units. Unit Project Officers appointed by the Unit Commanding Officer's / Officer Commanding's were also a great help and ensured that the mail surveys were distributed, completed by respondents and returned for analysis within a short time frame of two weeks.

Confidentiality

Recipients of mail surveys were assured of anonymity and confidential treatment of information they provided. Consequently in the analysis of responses, individual

names or shift crew identifiers are not disclosed and only aggregate statistics are provided. Where individual respondents wrote their name or appointment on the mail surveys it was removed.

Copies of the results of the initial and follow-up mail surveys have been forwarded to the four Army Signals units concerned and to the Head of Corps, Royal Australian Corps of Signals.

Data Processing

Once the initial Mail Surveys were completed they were forwarded to the author by the Unit Project officers through the Defence Mail System. The mail surveys were then checked for completion and bundled into unit lots. Unit Project Officers tended to forward them in shift crew lots as opposed to collating and forwarding them all at once.

The Information Technology Centre at Victoria University of Technology (Footscray Campus) processed the raw census data utilising the software package Statistical Package for Social Sciences (SPSS). A cross tabulations procedure was then used to test the relationship of selected variables, for example, gender, work pattern, roster preference, attitude, satisfaction and time on shift which were considered potential determinants of acceptability of shift working rosters.
The follow-up mail surveys were analysed manually and mean and median values calculated to allow a simple but meaningful comparison to be made.

CHAPTER FOUR

FINDINGS

PRELIMINARY INTERVIEWS

Roster Design Comparison

The aim of the preliminary interviews was to facilitate an in depth understanding of the shift working rosters in use, to develop an awareness of the reasoning behind their development or selection and to engender support for the study in each of the four unit locations.

As a result of the preliminary interviews, four different rotational shift rosters were found to be in practice. There were three, four crew roster variants used in Brisbane, Melbourne and Sydney and a five crew roster used in Canberra. The structure of each roster is detailed below:

a. **4 Signal Regiment, Brisbane**

Table 2 - 4 Crew, Forward Rotating, 28 Day Roster.

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	D	D	D	D	D	D+	D+
2	E	E	E	E	E	R	R
3	R	R	R	R	R	N+	N+
4	N	N	N	N	N	R	R

Where: D = Day Shift (8 Hour) 7:00 am - 3 :00 pm.

D+ = Day Plus Shift (12 Hour) 7:00 am - 7:00 pm.

E = Evening Shift (8 Hour) 3:00 pm - 11:00 pm.

N = Night Shift (8 Hour) 11:00 pm - 7:00 am.

N+ = Night Plus Shift (12 Hour) 7:00 pm - 7:00 am.

R = Rest Period.

This roster is characterised by twelve consecutive working shifts (day and evening) before a seven day break. The rest period is followed by seven straight night shifts and a short weekend (from Saturday morning) off. All Monday to Friday working shifts are eight hours in duration whilst weekends are twelve hours. On average, 42 hours per week are worked during the 28 day cycle.

b. **6 Signal Regiment, Melbourne.**

Table 3 - 4 Crew, Forward Rotating, 28 Day Roster.

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	D	D	D	D	D	D+	D+
2	E	E	E	E	E	R	R
3	R	R	R	N	N	N+	N+
4	N	N	N	R	R	R	R

Where: D = Day Shift (8 Hour) 7:00 am - 3 :00 pm.

D+ = Day Plus Shift (12 Hour) 7:00 am - 7:00 pm.

E = Evening Shift (8 Hour) 3:00 pm - 11:00 pm.

N = Night Shift (8 Hour) 11:00 pm - 7:00 am.

N+ = Night Plus Shift (12 Hour) 7:00 pm - 7:00 am.

R = Rest Period.

This roster is characterised by twelve consecutive working shifts (day and evening) before a five day break. The rest period is followed by seven straight night shifts and a four day break. All Monday to Friday working shifts are eight hours in duration whilst weekends are twelve hours. On average, 42 hours per week are worked during the 28 day cycle. The night shift of seven days is preceded and followed by the two rest periods in the 28 day cycle. It is the positioning of the rest periods on either side of the night shift which makes this roster different to the 4 Signal Regiment roster.

c. **134 Signal Squadron.**

Table 4 - 4 Crew, Forward Rotating, 28 Day Roster.

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	D	D	D	D	D	D+	D+
2	E	E	E	E	E	R	R
3	N	N	N	N	N	N+	N+
4	R	R	R	R	R	R	R

Where: D = Day Shift (8 Hour) 7:00 am - 3 :00 pm.

D+ = Day Plus Shift (12 Hour) 7:00 am - 7:00 pm.

E = Evening Shift (8 Hour) 3:00 pm - 11:00 pm.

N = Night Shift (8 Hour) 11:00 pm - 7:00 am.

N+ = Night Plus Shift (12 Hour) 7:00 pm - 7:00 am.

R = Rest Period.

This roster is characterised by twelve consecutive working shifts (day and evening) before a weekend break. This short rest period is followed by seven straight night shifts and a seven day break. All Monday to Friday working shifts are eight hours in duration whilst weekends are twelve hours. On average, 42 hours per week are worked during the 28 day cycle. This shift roster differs from the other two four crew roster systems because the principal rest period occurs at the end of the shift cycle.

d. **135 Signal Squadron.**

Table 5 - 5 Crew, Forward Rotating, 15 Day Roster.

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	D	D	D	E	E	E	N
2	N	N	R	R	R	R	R
3	R	D	D	D	E	E	E
4	N	N	N	R	R	R	R
5	R	R	D	D	D	E	E

Where: D = Day Shift (8 Hour) 7:00 am - 3 :00 pm.

E = Evening Shift (8 Hour) 3:00 pm - 11:00 pm.

N = Night Shift (8 Hour) 11:00 pm - 7:00 am.

R = Rest Period.

This roster is highlighted by nine consecutive shifts of work before a six day break falls due. The 15 day cycle length offers quick turnaround and a higher degree of flexibility for manoeuvring staff on and off the roster. All shifts are eight hours in length and an average 33.6 hours per week are worked.

Design Summary

The underlying design feature of the four individual rosters was the need to meet the operational requirement within the constraints of the unit establishment. The DISCON system was required to be in operation 24 hours a day, seven days a week. Although all units preferred the documented five crew shift roster, insufficient staff numbers restricted the use of this roster in all bar one location. Five crew shift roster

aside, it was also noted that each unit had a particular preference for their own shift roster design.

A surprising aspect of the interviews was although there were great concerns about the welfare / fatigue / performance levels of the individual shift worker, it was expected that they would not only perform their shift working duties but attend training and other unit activities during their rostered time off. This became a particular problem for those working a 4 crew roster, as their average 42 hours of shift work per week could be supplemented with a training activity of four to eight hours duration and a unit parade of one hour on a regular weekly or fortnightly basis. Five crew shift workers who would work an average of 33.6 hours per week could attend a similar number of unit activities and still work less hours overall than those on a standard four crew roster. Shift crews did operate at a minimum manning level and some of the work load, particularly during the peak periods, was allocated to increment or supplementary staff. Nonetheless, the hours in attendance by shift workers could exceed 45 -50 hours per week average.

Innovative Approaches

Generally speaking, the design and development of the shift working rosters under study were as a result of personal experience and preference. Roster development or change was somewhat hindered by establishment staffing levels where limited human resources forced units into considering only four crew roster systems. Lack of formal training into shift roster design and consideration was apparent and there were few, if any, opportunities to try new four or five crew shift rosters. There was

an overwhelming faith in the 'system' and an apparent resistance to change / acceptance of the status quo which in many cases stifled the generation of new ideas.

MAIL SURVEYS

The aim of the initial mail survey was to explore shift roster preference, satisfaction and several other potential variables and the results from the analysis of this document would underpin the study. As a direct result of a concern about the validity or importance of some of the information collected, a follow-up mail survey was used to clarify some of the data obtained in the original mail survey document.

Shift Working Preference

Table 6 shows that of the seventy-one respondents surveyed, only fourteen (19.7%) preferred shift work; an overwhelming majority of forty-four (62%) preferred day work.

Table 6 - Question 20: 'I Prefer Shift Working To Normal Day Work'.

Descriptor	Agree	Disagree	Did Not Know
Total	14/71 (19.7%)	44/71 (62%)	13/71 (18.3%)
Male	6/36 (16.7%)	22/36 (61.1%)	8/36 (22.2%)
Female	8/35 (22.8%)	22/35 (62.9%)	5/35 (14.3%)
Day Worker	7/19 (36.9%)	10/19 (52.6%)	2/19 (10.5%)
4 Crew Shift Worker	6/36 (16.7%)	22/36 (61.1%)	8/36 (22.2%)
5 Crew Shift Worker	1/16 (6.3%)	12/16 (75%)	3/16 (18.7%)
Supervisor	6/27 (22.2%)	17/27 (63%)	4/27 (14.8%)
Non Supervisor	8/44 (18.2%)	27/44 (61.4%)	9/44 (20.4%)
Time on Shift < 1 Year	7/37 (18.9%)	23/37 (62.2%)	7/37 (18.9%)
> 1 Year	7/34 (20.6%)	21/34 (61.8%)	6/34 (17.6%)

Although the same number of males and females expressed a preference for normal day work over shift work, a higher percentage of females (22.8% versus 16.7%) did indicate a preference for shift work.

When the data is broken down by the current shift roster system being worked by the respondent, some interesting results were obtained. Firstly, although over half (52.6%) of the day workers (those who had recently been rescheduled from shift work to day work) surveyed indicated a preference for day work, just over one third (36.9%), preferred shift work.

Secondly, only one of the five crew shift workers preferred shift working; seventy-five percent preferred normal day work despite the fact that the five crew roster was the most preferred roster system in use. What this result might suggest is that regardless of how good a shift roster is perceived to be, it is still no substitute for normal day work. In comparison, six of the four crew shift workers (16.7%), indicated a preference for shift work whilst 61.1% preferred day work. Given the perceived advantages of five crew working over a four crew roster such as more useable time off, less nights worked in a row and less accumulated fatigue it was anticipated that a higher percentage of four crew shift workers would prefer normal day work. This was not the case and may be attributed to the degree of familiarity or "comfort" shift workers had with their own roster.

Supervisors and non supervisors expressed similar preferences of just over sixty percent against shift working, however, a higher percentage of supervisors indicated

they preferred shift working because they had more control over the work that they did, could take on more responsibility and display higher levels of initiative. There was no indication in the data obtained that the length of time a shift worker had experienced on shift work impacted on preference one way or the other. The data presented in Table 6 replicates the findings of previous surveys namely, that workers prefer normal day work to shift work.

As part of the mail survey, it was of interest to determine whether experience in working over a range of shift roster systems would influence the choice of roster preferred. Forty-one percent of those surveyed had only worked on the shift roster they were currently associated with. Twenty percent had worked on two different rosters and thirty-nine percent had worked on three or more shift rostering systems. Ordinarily, personal experience in working over a wide range of shift working rosters would play an important part in shift roster preference, however, in the case of DISCON shift workers, the posting cycle between units and the regular communication between units ensured that the majority of shift workers were aware of the shift systems being used elsewhere within the network. The results shown in Table 7 support this claim.

Irrespective of the current roster being worked, the majority of respondents expressed a markedly high preference for the five crew shift roster. The preference for the five crew roster was not influenced by the number of different roster systems shift workers had been employed on and time spent on shift work did not have a large effect. Those shift workers who had not personally experienced the five crew roster had heard about it and there were generally moves within units to utilise such

when manning levels permitted. This was however unlikely to occur in the current establishment climate. Only 19.4% of 4 crew shift workers preferred their current shift roster - 4 crew with eight hour weekday working with twelve hour weekend shifts. None of the respondents selected the four crew, 8 hour shift working roster. This result was anticipated principally because this particular roster is not used within the DISCON environment as there are inherent difficulties in programming adequate rest periods during the shift cycle. Such a roster would also conflict with some of the established roster design criteria.

Table 7 - Question 12: 'What Shift Roster Do You Prefer The Most?'

Descriptor	5 Crew, 8 Hour Working Only	4 Crew, 8 Hour Working Only	4 Crew, 8 Hour Weekday, 12 Hour Weekends	4 Crew, 12 Hour Working Only	No Preference
Total	61/71 (85.9%)		7/71 (9.9%)	1/71 (1.4%)	2/71 (2.8%)
Male	30/36 (83.3%)		5/36 (13.9%)	1/36 (2.8%)	
Female	31/35 (88.6%)		2/35 (5.7%)		2/35 (5.7%)
Day Worker	18/19 (94.7%)			1/19 (5.3%)	
4 Crew Shift	27/36 (75%)		7/36 (19.4%)		2/36 (5.6%)
5 Crew Shift	16/16 (100%)				
Supervisor	24/27 (88.9%)		2/27 (7.4%)	1/27 (3.7%)	
Non Supervisor	36/44 (81.8%)		5/44 (11.4%)		3/44 (6.8%)
Time on Shift					
< 1 Year	31/37 (83.8%)		4/37 (10.8%)	1/37 (2.7%)	1/37 (2.7%)
>1 Year	26/34 (76.5%)		2/34 (5.9%)		6/34 (17.6%)

In summary, there was a clear preference for the 5 crew roster system from all sections of the sample. The reasons for this preference are presented in Table 8.

Table 8 - Question 13: 'I Prefer This Shift Roster (*5 Crew*) Because .....'.

Descriptor	Feel Fresh	Comm With Other Workers	Less Errors / Mistakes	More Control	Work Less Hours	Did Not Know
Total	50/61 (82%)	3/61 (5%)	1/61 (1.6%)	2/61 (3.2%)	5/61 (8.2%)	
Male	26/30 (86.7%)	2/30 (6.7%)		1/30 (3.3%)	1/30 (3.3%)	
Female	24/31 (77.4%)	1/31 (3.2%)	1/31 (3.2%)	1/31 (3.2%)	4/31 (13%)	

Of the sixty-one respondents who selected the five crew system as their most preferred shift roster, eighty-two percent indicated that it was because they 'felt fresh throughout the cycle and can concentrate and do their job well'. As research has consistently indicated, fatigue is one of the most important problems relating to shift work and is one of the main reasons why shift workers do not like shift work. A surprisingly low 8.2% of respondents who indicated a preference for the five crew roster stated that it was because they worked less hours than the 4 crew roster.

Respondents were also asked to indicate which of the rotational shift rosters they least preferred. The results appear in Table 9. The four crew roster systems used by three of the units were selected as the least preferred option. These four crew rosters involved respondents working twelve hour shifts during the weekend periods. Twelve hour working, particularly when the work load is physically or mentally demanding, is tiring and chronic fatigue may occur. Shift rosters involving twelve hour weekend working may not be suitable for the operational environment that these shift workers are employed within. If fatigue is considered to be a problem at this level of twelve hour working then permanent shifts of twelve hours should not be considered as a viable option at all. The fatigue factor accounts for the nearly

forty percent of the respondents who least preferred twelve hour shift working all of the time - a shift system not in use at any of the surveyed units.

Table 9 - Question 14: 'What Shift Roster Do You Least Prefer?'

Descriptor	5 Crew, 8 Hour Only	4 Crew, 8 Hour Only	4 Crew, 12 Hour Weekends	4 Crew, 12 Hour Only	No Preference
Total		6/71 (8.5%)	34/71 (47.9%)	28/71 (39.4%)	3/71 (4.2%)
Male		5/36 (13.9%)	19/36 (52.8%)	11/36 (30.5%)	1/36 (2.8%)
Female		1/35 (2.8%)	15/35 (42.9%)	17/35 (48.6%)	2/35 (5.7%)
Day Worker		2/19 (10.5%)	8/19 (42.1%)	9/19 (47.4%)	
4 Crew Shift		3/36 (8.3%)	16/36 (44.5%)	14/36 (38.9%)	3/36 (8.3%)
5 Crew Shift		1/16 (6.3%)	10/16 (62.5%)	5/16 (31.2%)	

Interestingly, the preferences varied with gender and work pattern with the trend being reversed between twelve hour weekend working and permanent twelve hour shifts. Females in this case least preferred permanent twelve hour working, whilst males least preferred twelve hour working during weekends. Five crew shift workers least preferred twelve hour weekend working whilst day workers indicated permanent twelve hour working as their worst option. Given the nature of the work, the high mental workload and the need for accuracy, twelve hour shifts are probably not appropriate.

It was however, anticipated that those rosters contributing to higher levels of fatigue would be least preferred. Service personnel are also aware that high performance levels are expected at all times. Fatigue being a contributor to decreased performance may have had an influence on their selection.

Sixty-two of the respondents indicated that twelve hour shift working, whether it be permanent shift or weekend working only, was their least preferred option. The reasons for this choice are shown in Table 10 below.

Table 10 - Question 15: 'I Dislike This Roster (*12 Hour Working*) Because .....'.

Descriptor	I Feel Tired	I Cannot Comm With Other Workers	I Make More Errors / Mistakes	I Have Less Control	I Work More Hours	Did Not Know
Total	54/62 (87.2%)	1/62 (1.6%)	1/62 (1.6%)	3/62 (4.8%)	3/62 (4.8%)	
Male	28/31 (90.4%)	1/31 (3.2%)		1/31 (3.2%)	1/31 (3.2%)	
Female	26/31 (84%)		1/31 (3.2%)	2/31 (6.4%)	2/31 (6.4%)	

The results support the argument that fatigue levels play an important part when considering or evaluating shift roster systems for implementation. Twelve hour working was disliked principally because respondents felt that they would feel tired during the shift roster cycle and would not be able to concentrate and do their job well; eighty-seven percent were of this view.

Satisfaction

The level of personal satisfaction was initially measured by asking shift workers to rate the statement 'I get more personal satisfaction from doing my job when I am on shift' (see Table 11). Even though there was a clear preference for normal day working over shift working, just over half of the respondents indicated that they did get more personal satisfaction when working on shift.

Table 11 - Question 40: 'I Get More Personal Satisfaction When Working On Shift'.

Descriptor	Agree	Disagree	Did Not Know
Total	37/71 (52.1%)	11/71 (15.5%)	23/71 (32.4%)
Male	19/36 (52.8%)	5/36 (13.9%)	12/36 (33.3%)
Female	18/35 (51.4%)	6/35 (17.2%)	11/35 (31.4%)
Day Worker	8/19 (42.1%)	5/19 (26.3%)	6/19 (31.6%)
4 Crew Shift Worker	17/36 (47.2%)	5/36 (13.9%)	14/36 38.9%)
5 Crew Shift Worker	12/16 (75%)	1/16 (6.3%)	3/16 (18.7%)
Supervisor	14/27 (51.9%)	6/27 (22.2%)	7/27 (25.9%)
Non Supervisor	23/44 (52.4%)	6/44 (13.6%)	15/44 (34%)
Time on Shift			
< 1 Year	20/37 (54.1%)	9/37 (24.3%)	8/37 (21.6%)
> 1 Year	17/34 (50%)	2/34 (5.9%)	15/34 (44.1%)

The group who recorded the highest level of personal satisfaction were the 5 crew shift workers. Five crew shift workers work on a roster which has a number of perceived advantages. The roster is less physically and mentally taxing and less hours are worked overall per week when compared with the other rosters resulting in a lower level of shift worker fatigue. It was expected that the 5 crew shift workers would have a higher level of personal satisfaction because the 5 crew shift system is a less burdensome roster system. There is only a small difference in responses relating to gender, a large difference in responses between supervisors and non supervisors and a substantial difference attributed to length of time on shift.

Table 12 - Question 21: 'I Am Satisfied With My Current Shift Roster'.

Descriptor	Agree	Disagree	Did Not Know
Total	26/71 (36.6%)	28/71 (39.4%)	17/71 (24%)
Male	15/36 (41.7%)	13/36 (36.1%)	8/36 (22.2%)
Female	11/35 (31.4%)	15/35 (42.9%)	9/35 (25.7%)
Day Worker	5/19 (26.3%)	8/19 (42.1%)	6/19 (31.6%)
4 Crew Shift Worker	6/36 (16.7%)	19/36 (52.8%)	11/36 (30.5%)
5 Crew Shift Worker	15/16 (93.8%)	1/16 (6.2%)	

As was expected, a higher proportion of 5 crew shift workers indicated satisfaction with their current shift roster. The advantages of this roster over the others have been raised a number of times. Of interest, however, is the percentage of 4 crew shift workers who were not satisfied with their current roster; just over half (52.8%) expressed dissatisfaction. Previously, when 4 crew shift workers were asked what was their most preferred shift roster, seventy-five percent of them selected the five crew roster. The principal differences between the four crew and the five crew shift rosters under study is that four crew shift workers work longer periods without a break and work an average over 8 hours per week more than five crew workers. This factor may account for the high level of dissatisfaction.

Other employee satisfaction indicators such as the level of morale, attitude, training, autonomy and responsibility are gauged by supervisors and form part of the regular coaching and counselling sessions individuals, shift and day workers, receive and were not measured by the mail survey.

Job Description Index (JDI)

The results including unit averages obtained from the survey are summarised within Table 13.

Table 13 - JDI Results Summary

Unit	Shift System	No.	Work	Supervision	Promotion	Co-Workers	Total Score
135 Sig Sqn	5 Crew	18	9.7/18	14.4/18	2.9/9	12.8/18	39.8/63
4 Sig Regt	4 Crew	19	7.6/18	11.3/18	2.3/9	11.6/18	32.9/63
134 Sig Sqn	4 Crew	12	5.3/18	13/18	2.8/9	9.9/18	30.9/63
6 Sig Regt	4 Crew	22	5.7/18	11/18	2.2/9	10.4/18	29.3/63
		71					

Note: The scores for each criterion are averages calculated from the number of respondents from each unit.

The Job Description Index is designed to measure individual satisfaction across a number of domains or aspects of a job. These aspects cover the work itself, pay, promotions, immediate supervision and co-workers. Addition of the matching scores on these questions gives a measure of overall job satisfaction. In this case questions regarding pay were not used as respondents were remunerated under common conditions of service.

Although the work environments are essentially the same across all locations, the 135 Signal Squadron five crew shift members rated a higher degree of satisfaction for each of the four aspects measured - the work itself, supervision, promotion and co-workers -of the job.

The results relating to the 'work' aspect provided the most interesting finding with the largest difference in responses from the four units, the span being from 9.7 of 18 for 135 Signal Squadron to 5.3 of 18 for 134 Signal Squadron.

The 'supervision' aspect result with a span of 14.4 of 18 to 11 of 18 was unexpectedly higher than the other three measured aspects although this may be due to a reasonably high level of autonomy that shift workers experience when working on shift.

It was anticipated that the 'promotion' criterion would provide similar results because of the like environment and the fact that promotion followed the same principles and procedures and were ratified centrally for all units by the same authorities. What was surprising, however, was the consistent low scoring in this section for the four different units.

The difference between the results in the 'co-workers' criterion may be related to the stresses and strains relating to rotating shift work, rather than personality based problems.

The results obtained from the JDI survey were consistent with those attained by satisfaction related questions within the mail survey document. Workers on the five crew shift roster of 135 Signal Squadron recorded a higher degree of satisfaction on the four criteria than was the case for the four crew workers.

The Effect of Shift Work On Performance

A series of questions were asked within the mail survey to determine the effect that shift work had upon personal work performance.

Question 32 (Table 14) attempted to ascertain whether or not shift workers had a concern that shift working affected their personal work performance.

Table 14 - Question 32: 'I Am Concerned That Shift Work Affects My Personal Performance'.

Descriptor	Agree	Disagree	Did Not Know
Total	13/71 (18.3%)	37/71 (52.1%)	21/71 (29.6%)
Male	8/36 (22.2%)	21/36 (58.3%)	7/36 (19.5%)
Female	5/35 (14.3%)	16/35 (45.7%)	14/35 (40%)
Day Worker	6/19 (31.6%)	7/19 (36.8%)	6 /19 (31.6%)
4 Crew Shift Worker	6/36 (16.6%)	15/36 (41.7%)	15/36 (41.7%)
5 Crew Shift Worker	1/16 (6.3%)	15/16 (93.7%)	

Over half of the respondents indicated that they did not have a concern. This result was unexpected as other studies (for example Folkard and Monk, 1980; Smith, 1982) have demonstrated that shift work does have a negative effect on individual performance.

The extremely high disagreement by the five crew shift workers, nearly ninety-four percent, can be attributed to their roster. The five crew system offers eight hour per shift and although nine shifts are worked in a row, this period is followed by six rostered days off allowing for sufficient rest and recreation. As a result five crew shift workers suffer from far less fatigue than four crew shift workers. The preliminary interviews also confirmed that five crew shift workers were mindful of the experiences that four crew workers endure. The higher proportion of day workers indicating that they agreed that shift work affected their performance were

predominantly from four crew shift working units and had just returned to day work. A possible explanation for this is that the four crew shift workers would have worked at least six months on shift and would have completed over six cycles of their rotational roster. This is a long time on a roster which has only one restful break per cycle and as a result they would still be somewhat tired or run down. Question 25 sought to determine whether shift workers felt that they worked better when on shift. A number of the questions asked within the mail survey would provide some support for the reason why shift workers perceived they did work better. First hand knowledge of the operation suggests the opportunity to develop far more trade skills by taking on more responsibility and having a higher degree of control of their work, and responses to the following two questions in this section, were the principal reasons for this perception.

Table 15 - Question 25: 'I Feel That I Work Better On Shift'.

Descriptor	Agree	Disagree	Did Not Know
Total	32/71 (45%)	16/71 (22.6%)	23/71 (32.4%)
Male	19/36 (52.8%)	5/36 (13.9%)	12/36 (33.3%)
Female	13/35 (37.2%)	11/35 (31.4%)	11/35 (31.4%)
Day Worker	7/19 (36.8%)	6/19 (31.6%)	6/19 (31.6%)
4 Crew Shift Worker	16/36 (44.5%)	8/36 (22.2%)	12/36 (33.3%)
5 Crew Shift Worker	9/16 (56.3%)	2/16 (12.5%)	5/16 (31.2%)
Supervisor	14/27 (51.9%)	5/27 (18.5%)	8/27 (29.6%)
Non Supervisor	18/44 (40.9%)	11/44 (25%)	15/44 (34.1%)

Indications were that five crew shift workers felt that they worked better on shift than four crew shift workers.

Development of Skill Levels

As shown in Table 16 there was a strong indication that shift workers believed that shift working provided greater opportunity for developing their trade knowledge and skills and that they could gain more experience. This was seen as being important particularly since much of the practical trade knowledge was learned on-the-job and further training and promotional opportunities would be based upon individual performance and the application of trade knowledge. During the out of hours work periods, shift working provided opportunities to operate with less supervision and if the overall work load reduced, the scope to take on additional tasks increased.

Table 16 - Question 35: 'Shift Work Enables Me To Develop Far More Skills'.

Descriptor	Agree	Disagree	Did Not Know
Total	35/71 (49.3%)	9/71 (12.7%)	27/71 (38%)
Day Worker	8/19 (42.1%)	5/19 (26.3%)	6/19 (31.6%)
4 Crew Shift Worker	16/36 (44.5%)	3/36 (8.3%)	17/36 (47.2%)
5 Crew Shift Worker	11/16 (68.7%)	1/16 (6.3%)	4/16 (25%)
Supervisor	19/27 (70.4%)	2/27 (7.4%)	6/27 (22.2%)
Non Supervisor	16/44 (36.4%)	7/44 (15.9%)	21/44 (47.7%)

The results shown in Table 17 reinforce the premise that shift working offers more opportunities to demonstrate skill level. Shift work was seen to assist shift workers in demonstrating their trade knowledge and skills with those in supervisory positions and those working on five crew shift rosters providing the more positive responses. Again this may be linked to fatigue levels and the ability to concentrate on the job for longer periods.

Table 17 - Question 33: 'Shift Work Enables Me To Demonstrate My Trade Knowledge And Skills Far More Than On Day Work'.

Descriptor	Agree	Disagree	Did Not Know
Total	42/71 (59.2%)	15/71 (21.1%)	14/71 (19.7%)
Male	21/36 (58.3%)	6/36 (16.7%)	9/36 (25%)
Female	21/35 (60%)	9/35 (25.7%)	5/35 (14.3%)
Day Worker	9/19 (47.4%)	6/19 (31.6%)	4/19 (21%)
4 Crew Shift Worker	21/36 (58.2%)	8/36 (22.2%)	7/36 (19.4%)
5 Crew Shift Worker	12/16 (75%)	1/16 (6.3%)	3/16 (18.7%)
Supervisor	20/27 (74.1%)	4/27 (14.8%)	3/27 (11.1%)
Non Supervisor	22/44 (50%)	11/44 (25%)	11/44 (25%)
Time on Shift			
< 1 Year	20/37 (54.1%)	11/37 (29.7%)	6/37 (16.2%)
> 1 Year	22/34 (64.7%)	4/34 (11.8%)	8/34 (23.5%)

Supervision and Level of Control

There are other factors which have an impact on individual satisfaction with the shift roster, the job and work performance. These include the level of supervision and control an individual experiences on the job and the degree to which they can take on additional responsibility and display initiative. A number of questions were asked to determine the impact of shift work on these aspects.

Table 18 shows that very few of the respondents indicated that they received more supervision than was necessary to do the job although over half agreed that the level did vary throughout the shift cycle.

Table 18 - Question 39: 'When On Shift Work, I Feel That I Get More Supervision Than I Need To Do The Job'.

Descriptor	Agree	Disagree	Did Not Know
Total	3/71 (4.2%)	36/71 (50.7%)	32/71 (45.1%)
Male	2/36 (5.6%)	20/36 (55.6%)	14/36 (38.8%)
Female	1/35 (2.9%)	16/35 (45.7%)	18/35 (51.4%)
Day Worker	1/19 (5.2%)	9/19 (47.4%)	9/19 (47.4%)
4 Crew Shift Worker	2/36 (5.6%)	17/36 (47.2%)	17/36 (47.2%)
5 Crew Shift Worker		10/16 (62.5%)	6/16 (37.5%)
Supervisor		20/27 (74.1%)	7/27 (25.9%)
Non Supervisor	3/44 (6.8%)	16/44 (36.4%)	25/44 (56.8%)

The day shift was seen to be the time when workers received more supervision than was deemed necessary by the respondents. This was not surprising because the complete chain of command comprising various positions and appointments are present during the day shift component of weekdays.

A higher percentage of shift workers also indicated that they had more control of the work that they did when on shift work (see Table 19).

Table 19 - Question 38: 'I Have More Control Of The Work That I Do When I Am On Shift'.

Descriptor	Agree	Disagree	Did Not Know
Total	40/71 (56.3%)	10/71 (14.1%)	21/71 (29.6%)
Male	22/36 (61.1%)	4/36 (11.1%)	10/36 (27.8%)
Female	18/35 (51.5%)	6/35 (17.1%)	11/35 (31.4%)
Day Worker	11/19 (57.9%)	3/19 (15.8%)	5/19 (26.3%)
4 Crew Shift Worker	19/36 (52.8%)	5/36 (13.9%)	12/36 (33.3%)
5 Crew Shift Worker	10/16 (62.5%)	2/16 (12.5%)	4/16 (25%)
Supervisor	17/27 (63%)	2/27 (7.4%)	8/27 (29.6%)
Non Supervisor	23/44 (52.3%)	8/44 (18.2%)	13/44 (29.5%)

More supervisors felt that they had more control of the work done whilst over half of the non supervisors agreed with them.

Table 20 reinforces this view with nearly sixty percent of respondents indicating that shift work provided greater opportunities to accept more responsibility. Shift supervisors generally had more responsibilities than day workers of equivalent rank and status including being primarily responsible for ensuring that the network remained operational throughout the twenty-four hour period. This may account for their higher response, over seventy-four percent, than non supervisors. Five crew shift workers provided a similar, positive response. This may be explained by the fact that under unit arrangements, they tended to form smaller teams and share the work load more evenly.

Table 20 - Question 45: 'Shift Work Allows Me To Accept More Responsibility'.

Descriptor	Agree	Disagree	Did Not Know
Total	42/71 (59.2%)	15/71 (21.1%)	14/71 (19.7%)
Male	21/36 (58.3%)	6/36 (16.7%)	9/36 (25%)
Female	21/35 (60%)	9/35 (25.7%)	5/35 (14.3%)
Day Worker	9/19 (47.4%)	6/19 (31.6%)	4/19 (21%)
4 Crew Shift Worker	21/36 (58.2%)	8/36 (22.2%)	7/36 (19.4%)
5 Crew Shift Worker	12/16 (75%)	1/16 (6.3%)	3/16 (18.7%)
Supervisor	20/27 (74.1%)	4/27 (14.8%)	3/27 (11.1%)
Non Supervisor	22/44 (50%)	11/44 (25%)	11/44 (25%)

In addition to this over seventy percent of respondents also agreed that shift work provided more opportunity to exhibit initiative.

Table 21 - Question 44: 'Shift Work Allows Me To Take The Initiative More'.

Descriptor	Agree	Disagree	Did Not Know
Total	50/71 (70.4%)	8/71 (11.3%)	13/71 (18.3%)
Male	27/36 (75%)	4/36 (11.1%)	5/36 (13.9%)
Female	23/35 (65.7%)	4/35 (11.4%)	8/35 (22.9%)
Day Worker	9/19 (47.4%)	5/19 (26.3%)	5/19 (26.3%)
4 Crew Shift Worker	26/36 (72.2%)	2/36 (5.6%)	8/36 (22.2%)
5 Crew Shift Worker	15/16 (93.8%)	1/16 (6.2%)	
Supervisor	23/27 (85.2%)	3/27 (11.1%)	1/27 (3.7%)
Non Supervisor	27/44 (61.4%)	5/44 (11.4%)	12/44 (27.2%)

The results detailed in Table 21 shows that a higher proportion of supervisors believe that they can take the initiative more than non supervisors. Almost twice the number of those working on a five crew shift roster saw greater opportunities for taking the initiative than day workers whilst four crew shift workers indicated a result in between the previous two.

The Mail Survey results indicated that in those aspects which have a positive impact on job satisfaction, for example, the development of skills and trade knowledge and in the level of supervision and control of work, five crew shift workers responded more positively across the board than both day workers and four crew shift workers. The five crew shift not only has proved to be the most popular roster but the one which contributes the most towards enhancing job satisfaction.

Other Survey Questions

There were a number of other questions asked within the mail survey that will be used as an extension to this project. The results have been kept and may form the basis of additional study and research.

Roster Design Criteria

Chapter two detailed a list of roster design criteria that researchers generally agree would, if considered in the planning of shift roster systems, reduce organisational and individual problems relating to shift work. Shift workers' attitudes and satisfaction with the work and shift roster itself are inextricably bound together. Roster design criteria go a long way towards reducing both organisational and individual problems relating to shift work thereby promoting higher degrees of personal satisfaction and a more positive attitude.

As can be seen in Table 22, the five crew roster utilised by 135 Signal Squadron satisfies more of the roster design criteria than each of the four crew shift roster variants. It would have been possible for units to consider all of the roster design criteria when modelling their own shift rosters and as such, all criterion are considered to be relevant. As this was not the case, all four rosters have the potential for improvement if more of the criteria are taken into consideration.

Table 22 - Satisfaction Of Roster Design Criteria

Serial	Criterion Description	4 Sig Regt (4 Crew)	6 Sig Regt (4 Crew)	134 Sig Sqn (4 Crew)	135 Sig Sqn (5 Crew)
1.	There should be few nights in succession.	0	0	0	1
2.	The morning shift should not commence too early.	1	1	1	1
3.	Shift change times should be flexible.	0	0	0	0
4.	The length of shift should be related to the physical and mental work load.	0	0	0	1
5.	The night shift can be shorter than the day and evening shift.	0	0	0	0
6.	Short intervals of time off between shifts should be avoided.	0	1	0	1
7.	There should be some free weekends including at least two consecutive days off.	0	1	1	1
8.	The roster should be regular (no changing between crews or to other different rosters).	1	1	1	1
9.	Rosters should be predictable.	1	1	1	1
10.	Rotating shifts should rotate in phase delay sequence.	1	1	1	1
11.	Fixed shifts should be considered.	0	0	0	0
12.	Avoid calling shift workers in on their days off.	0	0	0	0
13.	Allow for naps to be taken during the night shift.	0	0	0	0
14.	Shift workers should choose their roster.	1	1	1	1
15.	The internal and external communication system should be enhanced.	0	0	0	0
16.	Training should be conducted throughout the shift cycle.	0	0	0	0
17.	Allowance should be made for transport and travel times.	0	0	1	1
18.	Benefits should be offered as compensation.	1	1	1	1
19.	Workloads should be structured such that task completion times can be chosen.	1	1	1	1
20.	Support services should be offered for those not coping with shift work.	0	0	0	0
	Totals:	**7**	**9**	**9**	**12**

A summary of the ratings individuals allotted particular roster design criteria is shown in Table 23. The results of the mail survey relating to the relative importance of roster design criteria were as expected and will be addressed in Chapter five.

Table 23 - Roster Design Criteria Results

Criterion	Shift Workers (Max. 90 Points)	Non Shift Workers (Max. 90 Points)	Total (Max. 180 Points)
1 - Few Nights in Succession	49	56	105
2 - Morning Shift Not Commence Too Early	45	45	90
3 - Shift Change Times Should Be Flexible	44	42	86
4 - Shift Length Related to Physical /Mental Load	52	52	104
5 - Night Shift Can Be Shorter	36	42	78
6 - Short Intervals of Time Off Should be Avoided	67	72	139
7 - Some Free Weekends + at Least Two Days Off	79	84	163
8 - The Roster Should be Regular	77	71	148
9 - Rosters Should be Predictable	85	79	164
10 - Rotations Should be in Phase Delay Sequence	68	68	136
11 - Fixed Shifts Should be Considered	67	56	123
12 - Avoid Calling Shift Workers in on Their Days Off	84	74	158
13 - Allow for Naps to be Taken During the Night Shift	58	55	113
14 - Shift Workers Should Choose Their Roster	74	55	129
15 - Communication System Should be Enhanced	59	55	114
16 - Training Should be Conducted Throughout Cycle	45	64	109
17 - Allow for Transport and Travel Times	60	60	120
18 - Benefits Should be Offered as Compensation	84	73	157
19 - Workloads Should be Structured	70	57	127
20 - Support Services Should be Offered	63	55	118
	Mean: 63.3	**Mean: 60.75**	

Evaluation of Roster Design Criteria Results

The three most important roster design criteria selected in descending order for both shift and non shift workers were:

a. Rosters should be predictable (scored 85/90 by shift workers and 79/90 by non shift workers totalling 164/180). The four individual unit shift rosters satisfied this criteria. Rosters were published well in advance and shift crew members were able to plan family and social activities well in advance. It was expected that this criterion would rate highly because of its potential impact on the shift workers ability to plan.

b. There should be some free weekends including at least two successive days off (79/90 and 84/90 = 163/180). Only the 4 crew, 4 Signal Regiment failed to completely satisfy this criteria. The scheduled weekends off commenced at 7:00 a.m. Saturday morning or 11:00 p.m. Friday night thereby interfering with the weekend. Again this criterion was expected to rate highly. Weekends are the times when most people plan social and travel activities. Sporting events and family affairs tend to be planned for the weekend.

c. Avoid calling in shift workers on their days off (84/90 and 74/90 = 158/180). Although all units claimed that they tried to avoid calling shift workers in to work during rest periods, it often occurred due to structured training, unit parades and administrative reasons. The majority of those interviewed prior

to the administration of the mail survey indicated that this situation was a problem.

The three least important roster design criteria in ascending order for shift and non shift workers were:

a. The night shift could be shorter than the other shifts (36/90 and 42/90 = 78/180). None of the units had considered shortening the length of night shift from the current eight hours during the week and twelve hours during the weekends. The five crew roster scheduled eight hours of work per shift regardless of the day of the week. Non shift workers were scheduled to work eight hour week days. The reason why non shift workers saw this criterion as being more important than shift workers was not able to be determined by this study.

b. The shift change times should be flexible (44/90 and 42/90 = 86/180). Again little or no consideration had been given to offering flexible shift change times for individuals or collectively. In some cases actual start times were organised to facilitate ease of travel and to avoid peak hour traffic however individual special start time arrangements were not considered unless extraordinary circumstances which warranted personal attention occurred. It was appreciated that individual start times would be extremely difficult to manage considering the other military activities such as physical training were

programmed for majority attendance either side of day shift changeover times.

c. The morning shift should not commence too early (45/90 and 45/90 = 90/180). All morning shift start times, 7:00 a.m., were organised for a number of reasons including so that the oncoming shift crew could avoid peak traffic, physical training could be scheduled prior to the normal day work commencement time of 8:00 a.m. and so that the spread of hours throughout all shifts was reasonable.

Shift workers rated the following three criteria as more important than the non shift (day) workers:

a. Shift workers should choose the roster they are to work under (74/90 versus 55/90). In all cases the majority of shift workers had contributed to discussions regarding the choice of the unit shift system however operational requirement and staffing levels prohibited the popular choice of the 5 crew system in all but one case. Non shift workers were not included in the selection process unless they were on a rest from shift work so it is not surprising that shift workers regarded this criterion more highly.

b. Structuring the workload so that the shift crew can choose when during the shift cycle particular tasks can be done (70/90 versus 57/90). All roster systems allowed for flexible task completion times where individual shift

crews could choose at what part of their shift cycle certain tasks could be done. Shift workers viewed shift work as the opportunity to take on more responsibility and to control the work that they did.

c. Offering benefits as compensation (84/90 versus 73/90) for working shifts. Apart from Extra Recreational Leave (a maximum of five days per year can be approved by unit Commanding Officers), there is no provision or allowance made for compensating shift or other workers for extended or otherwise not normal hours worked.

Non shift (day) workers rated the conduct of training throughout the shift cycle (64/90 versus 45/90) as being more important than shift workers. Apparently non shift workers believed that shift workers missed out on the normal training regime.

On average, shift workers rated the roster design criteria slightly higher than non shift workers. Both rated half the design criteria more or less the same and clearly only two were regarded as not being important at all. These were:

a. The night shift could be shorter than the day or evening shift (36/90 and 42/90 = 78/180).

b. The shift change times should be flexible (44/90 and 42/90 = 86/180).

These two criteria were not considered by any of the units when they designed their shift rosters and as such had no impact on the statistical comparison shown in Table 23.

CHAPTER FIVE

DISCUSSION

Shift Worker Preference

A number of questions throughout the mail survey document sought to determine respondent preference working on shift. Previous research had shown that few shift workers like or have a preference for shift working and it was expected that this study would reinforce that premise. It was interesting to note that in this study a higher percentage of females (22.8% versus 16.7%) expressed a preference for shift work. This may be because of the perceived ability of females to cope better with fatigue and stress as compared to males (Kolmodin-Hedman, 1982, p. 448). Singer (1989, p. 25) also reports that where female and male shift workers are compared in survey type studies like this, women usually show greater satisfaction and better ability to cope with the rigours of shift working.

It was also interesting to note that a high proportion of day workers (just over one third) who had recently been rescheduled from shift work to day work preferred shift work. A possible explanation for this result may be that they believed that there was greater opportunity to take on additional responsibilities, control the work that they did and display initiative. Some reinforcement for this was attained through the mail survey document which established that day workers perceived that they received more supervision than was necessary during day shift. Day workers also considered there were greater opportunities to gain experience, exhibit trade skills and

knowledge during shift work and that they could take more control of the work that they were responsible for.

The results of the mail survey also reinforce the research that Knauth reported in 1989. As a result of his studies with shift workers from over 600 different shift rosters he concluded that shift workers very often selected their own roster when given a choice of work pattern. Kolmodin-Hedman (1982, p.455) also noted this observation as "conservatism of the people; they often like the present system even if it seems to be a very awkward one". The present survey only supported this view to a small extent. This was probably due to a high degree of knowledge of and in some cases practical experience with the five crew shift roster system throughout the survey sample.

A low proportion of respondents indicated a preference for the five crew shift roster because they worked less hours than those on a four crew roster. This result was surprising and may be attributed to a number of factors such as job satisfaction, challenging work, team and unit morale which if considered more important will reduce the significance of hours of work. Interestingly, more females than males, four to one, expressed this preference. This may have been related to regular family or social commitments. Other reasons such as the ability to communicate with other workers, the likelihood that fewer mistakes or errors would be made and higher levels of control of work to be completed were not considered as important in determining roster preference.

The results of the mail survey regarding reasons for disliking a particular shift roster reinforce surveys conducted by Rowland (1986), Singer (1989) and Wallace (1989). Fatigue was the principal factor for disliking a particular roster in the current survey whilst previous research determined that fatigue was a problem where the nature of the physical or mental workload was not suitable for long working hours.

Satisfaction

As indicated earlier in this paper, many surveys have demonstrated that aspects of shift rosters and the task at hand have a relationship with an individual's satisfaction with shift work. This study sought to gain an indication of the comparative levels of shift worker satisfaction with work and to determine whether a particular shift roster being utilised within the DISCON environment offered a higher degree of satisfaction overall.

Satisfaction was measured in two ways. Firstly, the level of personal satisfaction were measured through survey questioning. Secondly, the level of job satisfaction was measured through an established tool known as the Job Description Index (JDI) (O'Brien et. al, 1977). The Job Description Index is designed to measure satisfaction across five domains or aspects of the job - with the work itself, pay, promotions, immediate supervision and co-workers. Addition of the matching scores on these questions gives a measure or indication of overall job satisfaction.

Although there was a clear preference for normal day working over shift working, over half of the respondents indicated that they get more personal satisfaction when

working on shift. As the work is essentially the same for all (on shift and off shift) workers, it can be assumed that other factors play an important role in this response. Part of the explanation for this is that satisfaction may be influenced by the ability to develop and display trade knowledge and skills, levels of supervision, control of tasking and acceptance of responsibility - all aspects which respondents felt were more available on shift work.

Job Description Index (JDI)

The Job Description Index is designed to measure individual satisfaction across a number of domains or aspects of a job. These aspects cover the work itself, pay, promotions, immediate supervision and co-workers. Addition of the matching responses on these questions gives a measure of overall job satisfaction. In this case questions regarding pay were not used as respondents were remunerated under common conditions of service.

Although the work environments are essentially the same across all locations, the 135 Signal Squadron five crew shift members rated a higher degree of satisfaction for each of the four aspects measured - the work itself, supervision, promotion and co-workers -of the job.

The results relating to the 'work' aspect provided the most interesting finding with the largest difference in responses from the four units, the span being from 9.7 of 18 for 135 Signal Squadron to 5.3 of 18 for 134 Signal Squadron. This is likely to be as a result of the degree of satisfaction with the shift rostering system although other

influences such as leadership and management skills displayed within the unit and morale may have had an effect.

The 'supervision' aspect rated higher than any of the other three domains with a span of 14.4 of 18 for 135 Signal Squadron to 11 of 18 for 6 Signal Regiment. This was not surprising because of the higher levels of autonomy experienced by shift workers whilst on the job. This result will endorse that leadership and management skills, at least at the on-the-job work place level, will play some part in establishing levels of satisfaction. It may be coincidental that 135 Signal Squadron and the five crew system rated higher as the supervisory structures and chain of command were very similar across the four units. It is known however, that the five crew shift workers from 135 Signal Squadron are aware that the more senior officers within this unit are committed to continuing with the five crew roster even though the manpower costs are higher and this does not sit well in an environment of reducing staffing levels.

It was anticipated that the 'promotion' criterion would provide similar results (a span of 2.9 of 9 to 2.2 of 9) because of the like environments and the fact that promotion followed the same principles and procedures and were ratified centrally for all units by the same authorities. What was surprising, however, was the consistent low scoring in this section for the four different units. Individual units and the Corps of Signals do provide career management advice and planning whilst each posting and position is seen to fulfil specific requirements for selection based on merit for attendance at trade and promotion courses and subsequent progression through the

ranks. In this case 'promotion' was considered to be a poor or inappropriate measure of determining job satisfaction.

The difference between the results in the 'co-workers' criterion, 12.8 of 18 to 9.9 of 18, may be related to the stresses and strains relating to rotating shift work, rather than personality based problems.

What became apparent was that the JDI results show that there is a greater degree of job satisfaction across the board with 135 Signal Squadron. The higher degree of job satisfaction could be, despite anything else, a direct result of the five crew shift rostering system. This result was expected and is in part what the paper set out to test.

The Effect Of Shift Work On Performance

Performance measurement in any enterprise more often depends upon the nature of the enterprise and the products that it produces. The number of tons of steel produced by a steel mill in a given time can be readily measured. The number of assembled motor vehicles which come off a production line within a working shift can also be easily measured. Shift or team performance can readily be compared. Any improvements in the production process will be reflected in the output results.

Performance measurement in the DISCON service environment is a much more difficult task. DISCON is operational 24 hours a day, 7 days a week, 365 days a year, year in and year out. The system is staffed by shift workers who work in a

variety of shift rosters and the workload is not consistent throughout the working day. There are peaks and troughs which relate to the input of formal message traffic by subscribers to the system. The busiest times of work tend to be from mid morning through to early evening but these can change quickly according to the needs of the subscribers and the operational situation.

In addition to measuring job satisfaction and satisfaction with shift rosters it was hoped that quantitative measures of productivity and performance would support which was the 'best' shift roster. A number of measures were considered however due to the inconsistencies in their use and the lack of available raw data they were not used. Surprisingly, the use of purely specific output indicators such as the number of messages passed and error rates had little importance to those who managed the communications system because of the vast variation of work load across the board and the fact that they were not measured by supervisors. Cost indicators associated with traffic flow for example, reception, processing, transmission, receipt and delivery again provide no real indication of productivity or performance.

Human resource and labour indicators such as absenteeism, labour turnover and time lost due to industrial action are not appropriate because Army personnel have particular terms and conditions of employment and service imperatives to follow. Absenteeism is discouraged by disciplinary action, term of service is determined by contract and industrial action is prohibited. Loss of work time due to work place injury and accidents can be assessed, however, one must be careful to ensure that the

time actually lost was caused by an event directly related to the principle task and not physical or recreational training. Clearly the majority of work related injuries are caused during field exercises, physical training and sporting activities. The maintenance of a high level of physical fitness is a necessary part of military life and has a positive impact on individual and group performance by enhancing team effectiveness. Records of lost work time accidents and injuries are kept but only at higher levels of authority and these are not readily available to units.

Quality indicators such as the level of customer satisfaction, message delivery time registers, numbers of errors, readability of messages, retransmits, lost messages and security violations are recorded within log books however these were not made available for security reasons. During the preliminary interviews it became apparent that these tended to be used for individual performance counselling during the annual performance assessments (Annual Confidential Reports) and periodic coaching or more advanced training sessions.

It is well documented (Alluisi and Morgan, 1982; Bjerner et al., 1955; Fly, 1980; Folkard and Monk, 1980; and Hamelin, 1987 to list a few) that shift work does have a negative effect on individual performance at work and that fatigue and loss of concentration contribute to a drop in personal work performance. Respondents to the mail survey supported this view.

The mail survey results were as expected with five crew shift workers rating themselves as feeling that they work better than four crew shift workers. An

explanation for this may include reasons such as five crew shift workers feeling fresh or less tired - they work less hours and have more useable time off than the others; and as such feel that they are less likely to make errors or have lapses of concentration resulting in mistakes. A higher percentage of supervisors felt this way as well. This may be attributed to the opportunity that shift work presents to take on more responsibility and control of the work, particularly during out of normal office hours periods. The reason for a higher percentage of males feeling that they work better on shift is not known.

Development of Skill Levels

Shift work can provide some opportunities which those who are employed on normal day work often miss out on. The development of additional or higher skill levels is one such opportunity. This often occurs because evening and night as well as weekend shifts are staffed to the lowest possible levels and as generally there is less supervision provided, this can result in all shift crew members sharing the overall work load with everyone taking on more responsibility. The ability to learn and apply new knowledge will have a positive impact upon worker satisfaction. To determine if this occurs within the DISCON system, a series of questions were asked which addressed the opportunities to develop and demonstrate trade knowledge and skills.

Supervisors saw shift work more as an opportunity than non supervisors to develop their skills. An explanation for this is that those shift workers without supervisory responsibilities would be supervised to almost the same level whether they were on

day work or shift. The degree of direct supervision, however, may be more relaxed because of the reduced formality associated with shift work and the fact that it is highly unlikely that the more senior officers and non-commissioned officers would be present. During the out of hours periods only the shift leaders / shift supervisors would experience less direct supervision or control from above.

Five crew shift workers also agreed that shift work enabled them to develop far more skills is that they would feel far more refreshed, less tired and more be able to maintain a higher level of concentration for longer periods than the other groups. This environment is more conducive to learning and in applying new found knowledge.

As an extension to the previous question, shift workers were also asked if shift work enabled them to demonstrate their trade knowledge and skills more than on normal day work. The results were as expected with shift workers indicating that this was the case.

Supervision And Level Of Control

An interesting result from the survey was that supervisors felt that they had more control of the work to be completed. A possible explanation for this is that a number of tasks are set to be completed by each shift crew however the shift leader is able to allocate priorities and determine which order they will be finished. This factor would help raise the level of job satisfaction within individuals and the crews.

Nearly sixty percent of respondents indicated that shift work provided greater opportunities to accept more responsibility. A higher proportion of supervisors also agreed. Again this may be related to the opportunity to learn new skills and apply such on the job within an environment supportive of individual and group professional development. Many of the routine maintenance tasks were also conducted during the normal day shift leaving more available time for learning.

Roster Design Criteria

The results of the follow-up mail survey relating to the relative importance individuals placed on roster design criteria were as anticipated. Predictability and some weekends off play an important part in the life of the shift worker. Shift workers need to be able to plan their time off shift particularly where family relationships and social activities play a large part in an individual's life. Rotational rosters can be difficult to understand even for shift workers let alone their families when cycle lengths are long and there is much changing from day to evening to night shifts. The difficulty can be compounded if individuals are required to work at different sites. The simpler the roster is in design by nature the easier it is to comprehend. Publishing the rosters well in advance facilitates understanding and planning work requirements well into the future.

The need for weekends off and including at least two days off when this is not always possible allows for rest and normal recreation. Society generally caters for week day workers by providing special activities during the weekends. Weekends are also a time when families can normally get together to spend some time. It is not

surprising that this criterion was considered important by both shift and non shift workers alike.

No one likes being called into work on their days off particularly when there is no apparent compensation for doing so. There is an expectation that this will not occur unless the circumstances are considered most important. In this study it was found that all units had a tendency to program a number of activities such as unit parades, training and other exercises at times which would have an impact on the shift worker by either increasing the length of time that they were required at work or conducting such at weekends. This would result in increasing fatigue levels and potentially upset planned social or recreational routines. There was also an underlying notion that administrative matters could only be dealt with during normal hours resulting in shift workers having to attend their place of work earlier, stay later or come in on their days off to attend to pay or other administrative detail.

The benefits offered to shift workers as a means of compensation for shift work were seen to be important as well. Although the benefits were available to day workers as well the shift worker rated such much higher.

Interestingly, previous studies by Knauth (1982 and 1989) and Smith (1982) had shown that all of the prescribed roster design criteria were considered to be important. This study does not support that claim and a number of design criteria were identified by the survey sample as not being as important as others. The least important criteria related to shift timings and included what time the morning shift

should start and whether the change of shift timings should be flexible. These were rated at half the value of the most important. These criteria are generally considered more important outside of the survey environment where shift workers may have to make their own travel arrangements and travel for considerable times and distances. The low value placed on this factor by the survey respondents may be attributed to the close proximity shift workers lived in relation to place of work and where a considerable distance was involved unit transportation was made available from a central location to place of work and return.

Given that some of the roster design criteria did not mean much to those surveyed it cannot be stated that the more criteria satisfied the higher the potential level of individual satisfaction with the job and the roster itself as previous research has suggested.

The five crew shift roster utilised by 135 Signal Squadron satisfied more of the relevant roster design criteria than the other three unit rosters. It must be noted however, only twelve of the twenty (60%) roster design criteria were satisfied. Potentially, further improvements to the shift roster may be made.

Areas which could be considered further in shift roster design may include:

a. **Making the shift change times more flexible**. This may be difficult when taking into account the locations of the various operational sites in the main capital city based units and the requirement for particular staffing levels at

any one time. Traffic flow, distances to be travelled, the varying home locations of staff, national / international time based operational procedures, security processes etcetera may prohibit the general consideration of this element.

b. **The night shift timing could easily be shortened**. The length of the night shift could be shortened without having a negative impact on the staffing or the operational requirement. The day, the evening or both shift lengths could be increased by an hour thereby reducing the night shift to seven or six hours in duration. A six hour shift may be perceived as being too short particularly when taking into account the time it may take for some shift workers to get to work and then to travel home. A seven hour night shift may be more appropriate. This element does have an association with the previous one where the shift length should be related to the physical and mental workload. Only 135 Signal Squadron took this into account when designing their shift roster system. It must be noted however that this criteria was not considered to be essential as the physical and mental workload was somewhat reduced during the late evening and night shifts and that the survey respondents did not consider this criteria to be important for them.

c. **Implementation of fixed shifts and napping**. Consideration was not given to implementing fixed shifts or allowing napping during the night shift. Although few shift workers indicated a preference for working a particular shift units were inclined to rotate all staff through shift work rather than meet

individual preferences. Napping was generally not allowed because of reduced numbers on shift. This was due to unit efforts in trying to reduce the total numbers of staff working on rotating shift work to the minimum operational and safety requirement.

d. **Not calling shift workers in**. All units did attempt to avoid calling shift workers in during their days off shift, however, with the number of unit parades, inspections, military skills training activities eg. firing range practices, this was difficult to adhere to particularly with those rosters with long cycles (6 and 4 Signal Regiments, and 134 Signal Squadron).

e. **Communication processes**. With the exception of Operational Log Books and Handover / Takeover Briefings, no special effort had been put into place to enhance internal and external communication between individual crews and crews and the unit. The standard army practice of regular conferencing and briefings throughout the chain of command was considered to be sufficient for unit purposes in all cases.

f. **Training**. As part of the study and feedback, all units were considering conducting trade and other training during the total shift cycle. Shift crews would be given a number a training objectives to achieve during each cycle and they would decide when they would undertake the set requirements.

g. **Support services**. Although no special support services were being offered to those members not coping with shift work, consideration was being given

to conducting workshops designed to assist new members with developing strategies to help them deal with the rigours of shift work.

Potentially, the more roster design criteria taken into account when designing shift working rosters, the more positive the impact it has on the shift roster itself. It is accepted, however, that it would be extremely difficult if not impossible to apply them all due to the nature of the work within the defence environment and the operational imperative. Where possible, attention should be payed to addressing those criteria which are deemed important to the shift worker and not those considered to be unimportant.

Although it has been suggested by any number of independent researchers that adapting to shift work is a complex process involving the interaction of psychological, social and physiological factors, providing that the shift system is appropriate to their individual and work needs, most people are willing and can adapt.

CHAPTER SIX

CONCLUSION

Aim of Study

The aim of the study was to test the hypothesis that there is a positive relationship between shift roster design and individual satisfaction with, and preference for, particular shift rosters. In doing so four requirements needed to be satisfied:

a. Firstly, to review existing innovative approaches taken by units in the design of their shift working rosters.

b. Secondly, to determine which shift working roster is preferred by those working on shift within the system.

c. Thirdly, to determine which of the shift working rosters is designed most effectively in terms of established roster design criteria.

d. Fourthly, to develop, where possible, a better shift working roster model that can be implemented within DISCON.

This study confirms the hypothesis that there is a positive relationship between shift roster design and individual satisfaction with, and preference for, particular shift rosters.

Innovative Approaches

During the preliminary interviews it became apparent that little innovation was being applied to the development of rosters in the four units under study. This was mainly due to low establishment levels in three of the four units which was the principal reason why four crew rosters were employed by them and the fact that no supervisor or person involved in roster design had any formal roster design experience or knowledge of shift working practices and problems.

The only innovation shown by the four units was the minimisation of staff numbers being employed on shift work and their supplementation during busy periods by increment staff. This action occurred because of the low staffing levels rather than innovative thought.

Preferred Shift Roster

It was determined by mail survey that of the four shift working rosters under study that the five crew shift roster model was the preferred shift working system. A clear majority (over 85%) supported this claim and the result was consistent with the hypothesis.

When given the choice of working on shift work rather than normal day work only about one fifth preferred rotational shift working. This result supports previous research and established claims that the majority of people do not like or prefer shift work.

Roster Design

The four shift rosters were compared against established roster design criteria. Data regarding the shift rosters was collected by personal interview and mail survey. The five crew shift roster satisfied more of the roster design criteria than the four crew roster systems however it must be stated that all of the rosters studied could be improved if all of the roster design criteria were to be considered. If this was the case further study would be needed to determine the impact on shift worker satisfaction and roster preference.

Shift Roster Improvement

As noted previously, all of the four shift rosters under study could be improved if all of the established roster design criteria were taken into consideration when developing the shift system. Of the four rosters the five crew shift roster system employed by 135 Signal Squadron (Canberra) was considered to be the most suitable. Minor improvements can still be made to this roster by considering those roster design criteria elements which were previously not considered. Such a roster may be represented like the one shown in Table 24 on the next page.

Table 24 - Five Crew, Forward Rotating, 10 Day Shift Roster

Week	Mon	Tue	Wed	Thu	Fri	Sat	Sun
1	D	D	E	E	N	N	R
2	R	R	R	D	D	E	E
3	N	N	R	R	R	R	D
4	D	E	E	N	N	R	R

Where: D = Day Shift (9 Hour) 7:00 am - 4 :00 pm.

E = Evening Shift (8 Hour) 4:00 pm - 12:00 pm.

N = Night Shift (7 Hour) 12:00 pm - 7:00 am.

R = Rest Period.

The proposed roster has a number of advantages including:

a. Reducing the night shifts from 3 shifts to 2. This will minimise sleep deprivation and sleep deficit.

b. The length of shift is related to the physical and mental workload. The day shift is extended by one hour and night shift decreased by one hour. The current practice of supplementing day shift with increment staff during weekdays should continue will alleviate the workload during peak traffic periods. The shorter night shift will reduce boredom.

c. The frequency of time off is improved. Rest periods occur every 6 days as opposed to every 9 days.

d. Internal communication is enhanced with time away from work being reduced from 6 days every 9 to 4 days every 6.

e. This roster potentially satisfies more of the roster design criteria than the existing and well accepted 5 crew shift roster.

A good shift roster should motivate workers and contribute to a positive attitude towards shift working facilitating those on different shifts to work together towards a common goal. If a new shift work schedule has the support of managers and shift workers, they will find a way to make it work. If the commitment is not there, the alternative for most shift workers is to stay on the current schedule.

In addition to the above there are other innovations which can be considered:

a. The number of shift workers should be reduced to the minimum operational requirement. The shift workers can then be supplemented with increment staff to cover those periods where there is a heavy work load.

b. Elimination of unnecessary work procedures during the night shift. This will reduce unnecessary effort at a time when levels of attentiveness or concentration are at their lowest.

Attention is already being paid to the improvement of working areas, the elimination of health hazards, the introduction of shift worker support services and the review of social infrastructures such as transport and catering facilities.

The recommended 'new' model put forward in chapter six offers improvement in shift roster design particularly for the three units employing a four crew roster. The proposed five crew, forward rotating, 10 day shift roster displayed in Table 24 satisfies more of the roster design criteria than all of the rosters under study.

Conclusion

This study on shift working and shift rosters within a sector of the defence communications environment has not raised any new issues or concerns but has substantiated previous research in a number of areas. Certainly the study has reinforced that the majority of people do not like working on shift work and do so for particular reasons. Normally this is for higher pay and conditions or it is an essential part of the industry or employment workings. In this case it is because of the service imperative and sense of duty.

The study also endorses that when developing a shift roster the more of the established roster design criteria that can be satisfied or taken into consideration the more effective the shift roster will be. The shift roster design contributes much towards individual and group job satisfaction, individual and group preference for the roster itself, attitude to work and performance. The more positive the roster design is perceived the better the morale and esprit de corps and satisfaction overall.

The study also highlights the fact that innovation is lacking in roster design and development. Shift worker supervisors are not trained in shift roster design and development and tend to learn from their own and others' experiences. The service imperative and sense of duty often clouds rational and original thought.

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APPENDICES

Appendix 1: A Comparative Study of Shift Working Systems - Supervisor / Shift Leader Interview Master Copy (5 pages).

Appendix 2: Shift Worker Mail Survey Master Copy (8 pages).

Appendix 3: Follow-Up Mail Survey Master Copy (2 pages).

APPENDIX 1 TO

MASTER'S THESIS

A COMPARATIVE STUDY OF SHIFT WORKING SYSTEMS

P.J. BRYAR

SUPERVISOR / SHIFT LEADER INTERVIEW

BIOGRAPHICAL DETAILS

Unit:

Rank: Name:

Position: DISCON / COMMCEN

Time on Shift:

THE SHIFT ROSTER

The following questions relate to the design and development of your current shift working roster.

Q1. In a simple manner, can you explain the basis of your shift working roster? (Prompt where necessary for number of crews, working hours, average hours per week, length of cycle etc.).

Q2. How was this roster developed or what is the unit history of this roster?

Q3. Did you have any personal input to the development of this roster?

Q4. If so, what did you contribute?

Q5. Was there a contribution that you wanted to make but was blocked or not considered for some other reason?

Q6. What were (or what are) the main factors considered when the roster was designed?

Q7. What are your perceived advantages of this roster?

Q8. What are your perceived disadvantages of this roster?

Q9. Do you think that the current roster can be improved upon?

Q10. If so, how?

Q11. Have you had any personal experience of other rosters?

Q12. If so, what were they?

Q13. How do those other rosters compare?

Q14. Are you satisfied with the current roster?

Q15. Do you believe that the majority of shift workers in your unit are satisfied with this roster?

THE WORK REQUIREMENT

In this section I am going to explore the approaches taken to cater for the work requirement.

Q1. In what ways does the current shift roster cater for the variable work requirement?

Q2. Does this roster offer the flexibility that you need?

Q3. Is there a better way to approach the work requirement?

Q4. If so, what approach would you suggest?

INDIVIDUAL AND COLLECTIVE PERFORMANCE EVALUATION

In this section I am exploring how individual and collective performance is currently measured with the view of finding suitable performance indicators for future measurement.

Q1. Are you satisfied with the standard of work being performed by individuals on shift?

Q2. Are you satisfied with the standard of work being performed by shift teams themselves?

Q3. How do you currently evaluate individual performance?

Q4. How do you currently evaluate collective (shift team) performance?

Q5. Is there are better way of evaluating individual and collective performance?

Q6. Is there scope for improved performance in the workplace?

Q7. In what areas?

Q8. How would you measure any improvement achieved?

Q9. Do you believe that perceived poor performance or good performance can be directly attributed to the shift roster?

DEGREE OF SUPERVISION AND AUTONOMY

In this section I am reviewing the degree of supervision (both up and down) within the work place and the level of autonomy supervisors have.

Q1. As a Shift Supervisor, how much supervision do you receive in your daily duties?

Q2. Do you feel as if you are over supervised or under supervised?

Q3. If so, please explain.

Q4. Do you have enough training to do your job?

Q5. Will your performance improve with further training?

Q6. Do you have written orders and instructions to follow or set procedures?

Q7. If so, were you a part of their development?

Q8. Do you have enough responsibility, authority etc., to do your job?

Q9. Are you able to make decisions without recourse to your superiors?

Q10. Are you supported in your decisions whether they are right or wrong?

Q11. Do you actively supervise your own subordinates or leave them to get on with the job?

Q12. Qualify your answer.

PRODUCTIVITY IMPROVEMENT

In this section I will be looking at what opportunities are present for individuals and shifts to make suggestions for productivity improvement.

Q1. Are you encouraged to make suggestions to improve the quality of work produced?

Q2. Have you made any suggestions?

Q3. If so, were any of those suggestions implemented?

Q4. Did you receive recognition for your efforts?

Q5. If you could spread the workload over the 24 hour period, how would you do it?

Q6. Is continuous improvement encouraged in your work place?

Q7. Do you receive sufficient feedback as to your performance?

LEVEL OF COMMUNICATION

This section is designed to see what interactions the Shift Supervisor and Leader have with their shift team and to find out how difficult it is to communicate with those on other shifts.

Q1. Are you able to communicate readily with the majority of others in your unit?

Q2. Do you always get messages, instructions, written orders etc. in time for you to respond accordingly?

Q3. Do you know what is going on within your unit?

Q4. How is information normally passed on within the unit?

Q5. Do your subordinates use you to pass on their ideas and suggestions?

Q6. What types of interactions do you normally have with your shift eg. purely work, after hours sporting teams, etc.?

GENERAL

Is there anything else that you wish to say that might assist me in my study?

APPENDIX 2 TO
MASTER'S THESIS

From: Peter Bryar

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ELTHAM VIC 3095

Tel/Fax: (03) 431 3127
Mobile: (015) 261 142

December 1993

SHIFT WORKER SURVEY / QUESTIONNAIRE

Dear past or present Shift worker,

For the past nine months I have been researching shift working and roster design within Australian Army units associated with the strategic communications system.

There are three aims to my research:

a. To review existing shift working systems against roster design criteria and research guide-lines.
b. To review existing methods of individual and collective performance assessment for the purpose of designing a set of productivity indicators to facilitate productivity improvement and performance evaluation.
c. To review innovative approaches taken by units in the design and application of their shift working rosters.

You may recall me visiting your unit some months ago interviewing various supervisors and shift leaders.

To develop a more complete understanding of your experiences and attitudes towards the shift roster system you are currently working with I am asking **all past and present shift workers whose base trade is operator information systems** to complete this census. I will be asking a number of questions relating to your background, how you perceive shift working and your roster, the level of internal and external communication within your unit, and how you view your performance and level of productivity.

If you have **not worked on shift please do not fill in this questionnaire**.

In asking you to complete this census, I am committed to ensuring the confidentiality of your answers. No one at your unit will be in a position to see or analyse your answers. You will not have to put your name on the questionnaire. Only summaries of responses and copies of the completed study will be provided to your unit.

By answering all questions you will be making a valuable contribution towards the completion of this research and I trust eventually your conditions of work / service. Thank you for your assistance and co-operation in completing this survey.

GENERAL INSTRUCTIONS

There are three types of questions in this census. The first type requires you to mark one or more responses in numbered boxes e.g. [1]. Please mark your response by drawing a black line through the number e.g. [1]. If you wish to change your response draw a large cross through your incorrect response e.g. [1], and mark your new response.

The second type of question asks you to mark one of several numbers that appear on a scale to the right of the item. You are to choose the number (or numbers if requested) that best matches the description about how you feel about the item.

For example, if you were asked how much you agree with the statement, "I enjoy the weather in Melbourne", and you feel that you disagree, you would mark the number [2] under 'disagree' like this:

	Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
I enjoy the weather in Melbourne.	[1]	[2]	[3]	[4]	[5]

The third type of question will ask you to place a Y (yes it describes a particular aspect of your job), N (no it doesn't) or ? (if you are unsure) in the space provided.

Please answer the questions by thinking about your current job and working situation and use a black or blue biro for all responses. When you have finished, please place the questionnaire in a standard A4 envelope and return it to the designated Survey Facilitator. Please note the following definitions:

* **4 crew roster** - there are 4 different shift teams e.g. A, B, C and D shifts.
* **5 crew roster** - there are 5 different shift teams e.g. A, B, C, D and E shifts.
* **Forward rotating** - the shifts schedules rotate in the order of day shift to evening shift to night shift to day shift (rest periods can appear anywhere in the cycle).
* **Swing shift** - where you complete a particular shift e.g. 8 hour evening shift, and you have to work the following 8 hour morning shift and the effective break is the 8 hour night shift.
* **Supervisor** refers to the person to whom you report to directly in your primary duties.
* **Customers** in this case refers to external people to whom you transmit or receive messages for, provide advice to, or manage the communication system for.
* < means less than and > means greater than.

SURVEY / QUESTIONNAIRE

1. Are you?

Male	Female
[1]	[2]

2. What is your age in years?

< 20 years	21 to 25	26 to 30	>31 years
[1]	[2]	[3]	[4]

3. What is your worn rank?

SIG	LCPL	CPL	SGT	SSGT or >
[1]	[2]	[3]	[4]	[5]

4. What is your current work pattern?

Day Work only	[1]
4 Crew Rotational Shift Work	[2]
5 Crew Rotational Shift Work	[3]

5. I am currently working:

The Night Shift of my shift cycle	[1]
The Day Shift of my shift cycle	[2]
The Evening Shift of my shift cycle	[3]
Normal day work	[4]

6. Are you currently a supervisor?

Yes	No
[1]	[2]

7. Where are you currently working?

DISCON	COMMCEN	OTHER
[1]	[2]	[3]

8. How long have you been in your current position?

Less than 12 months	[1]
More than 1 year but less than 3 years	[2]
More than 3 years but less than 5 years	[3]

9. In the box below indicate your total work experience by ticking the appropriate cell(s). (Tick only those cells where you have had experience).

	Supervisor	**Day Work**	**4 Crew Shift**	**5 Crew Shift**
Not Rostered				
< 1 Year				
1 Yr < 3 Years				
3 Yrs < 5 Years				
> 5 Years				

10. How many different shift rostering systems have you worked on?
    - One roster only. [1]
    - Two different rosters. [2]
    - Three or more different rosters. [3]

11. I have worked on the following types of rosters (**mark all those applicable**)
    - 4 crew, 28 day roster with 8 hour shifts only. [1]
    - As for [1] but with 12 hour weekend shifts. [2]
    - 4 crew roster employing 12 hour shifts throughout the cycle. [3]
    - 5 crew, 15 day roster with 8 hour shifts only. [4]

12. What rotational shift roster system do you **prefer the most**?
    - 4 crew, 28 day roster with 8 hour shifts only. [1]
    - As for [1] but with 12 hour weekend shifts. [2]
    - 4 crew roster employing 12 hour shifts throughout the cycle. [3]
    - 5 crew, 15 day roster with 8 hour shifts only. [4]

13. I **prefer** this roster for the following **main** reason: (Pick one only).
    - I am fresh throughout the cycle and can concentrate on and do my job well. [1]
    - I can communicate with fellow shift and day workers. [2]
    - I can communicate with my customers. [3]
    - I believe I make less errors or mistakes throughout the cycle. [4]
    - I have more control of the work that I do. [5]
    - I work less hours on a 5 crew roster than I would on a 4 crew one. [6]

14. The rotational shift roster I **least prefer** is:
    - 4 crew, 28 day, roster with 8 hour shifts only. [1]
    - As for [1] but with 12 hour weekend shifts. [2]
    - 4 crew roster employing 12 hour shifts throughout the cycle. [3]
    - 5 crew, 15 day, roster with 8 hour shifts only. [4]

15. I **dislike** this roster for the following **main** reason: (Pick one only).
    - I feel tired during the cycle and cannot concentrate and do my job well. [1]
    - I cannot communicate with fellow shift and day workers. [2]
    - I cannot communicate with my customers. [3]
    - I make more errors and mistakes throughout the cycle. [4]
    - I have less control of the work that I do. [5]
    - I work more hours on a 4 crew roster than I would on a 5 crew one. [6]

16. Which part of the shift cycle do you **prefer the most**?
    - Day Shift. [1]
    - Evening Shift. [2]
    - Night Shift. [3]

17. I **prefer** this part of the shift cycle for the following **main** reason: (Pick one only).
    - I feel fresh cycle and can concentrate and do my job well. [1]
    - I can communicate with fellow shift and day workers. [2]
    - I can communicate with my customers. [3]
    - I make less errors and mistakes during this part of the cycle. [4]
    - I have more control of the work that I do. [5]

18. Which part of the shift cycle do you **least prefer**?

Day Shift.	[1]
Evening Shift.	[2]
Night Shift.	[3]

19. I **least prefer** this part of the shift cycle for the following **main** reason: (Pick one only).

I feel tired during the cycle and cannot concentrate and do my job well.	[1]
I cannot communicate with fellow shift and day workers.	[2]
I cannot communicate with my customers.	[3]
I make more errors and mistakes throughout the cycle.	[4]
I have less control of the work that I do.	[5]

		Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
20.	I prefer shift working to normal day work.	[1]	[2]	[3]	[4]	[5]
21.	I am satisfied with my current shift roster.	[1]	[2]	[3]	[4]	[5]
22.	My attitude to work is not affected by my shift roster.	[1]	[2]	[3]	[4]	[5]
23.	I do not feel tired during the shift cycle.	[1]	[2]	[3]	[4]	[5]
24.	I dislike shift work because I am supervised more than I would be on days.	[1]	[2]	[3]	[4]	[5]
25.	I feel that I work better on shift than on days.	[1]	[2]	[3]	[4]	[5]
26.	During the shift cycle my levels of concentration and attentiveness to the job varies because I am tired.	[1]	[2]	[3]	[4]	[5]
27.	I don't think that working a 12 hour shift throughout the whole shift cycle would effect my fatigue levels any more than 8 hour working.	[1]	[2]	[3]	[4]	[5]
28.	When I am on shift I always receive important messages in time for me to respond accordingly.	[1]	[2]	[3]	[4]	[5]

		Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
		[1]	[2]	[3]	[4]	[5]
29.	I find out more about what is happening within my unit through rumours than any other way.	[1]	[2]	[3]	[4]	[5]
30.	I feel isolated from the rest of the unit because of shift work.	[1]	[2]	[3]	[4]	[5]
31.	Whilst on shift work I am more able to discuss queries with customers than I could on days.	[1]	[2]	[3]	[4]	[5]
32.	I am concerned that my personal performance is effected by shift work.	[1]	[2]	[3]	[4]	[5]
33.	Shift work has enabled me to demonstrate my trade knowledge and skills far more than day work.	[1]	[2]	[3]	[4]	[5]
34.	I believe my error rate is effected by the position that I am in with my shift cycle.	[1]	[2]	[3]	[4]	[5]
35.	Shift work has enabled me to develop far more skills than I need to do my job.	[1]	[2]	[3]	[4]	[5]
36.	I have learned my job mostly through on-the- job training.	[1]	[2]	[3]	[4]	[5]
37.	Shift working has enabled me to gain more experience than I could on day work.	[1]	[2]	[3]	[4]	[5]
38.	I have more control of the work that I do when I am on shift.	[1]	[2]	[3]	[4]	[5]
39.	When on shift work, I feel that I get more supervision than I need to do the job.	[1]	[2]	[3]	[4]	[5]
40.	I get more personal satisfaction from doing my job when I am on shift.	[1]	[2]	[3]	[4]	[5]
41.	My job satisfaction is closely related to how much my customers are satisfied with the work that I do.	[1]	[2]	[3]	[4]	[5]
42.	The quality of my work depends upon how tired I am and my levels of concentration and attentiveness.	[1]	[2]	[3]	[4]	[5]

		Strongly Disagree	Disagree	Neither Disagree or Agree	Agree	Strongly Agree
		[1]	[2]	[3]	[4]	[5]
43.	I don't believe that the quality of my work varies or would vary if I had to work 8 or 12 hour shifts.	[1]	[2]	[3]	[4]	[5]
44.	I think that shift work allows me to take the initiative more than I would be able to do on day work.	[1]	[2]	[3]	[4]	[5]
45.	I think that shift work allows me to accept more responsibility than I would be able to accept on day work.	[1]	[2]	[3]	[4]	[5]
46.	I think that the level of supervision varies throughout the shift cycle.	[1]	[2]	[3]	[4]	[5]
47.	If I could, I would prefer to work a fixed shift e.g. evenings only, nights only.	[1]	[2]	[3]	[4]	[5]

48. Please list the measures or criteria that you consider would be a better indication of your work performance.

.....

.....

.....

.....

.....

.....

49. Please place a **Y** beside an item if the item describes a particular aspect of your job (work, supervision, promotion, co-workers), **N** if the item does not describe that aspect or **?** if you cannot decide.

a.	**Work.**	.....	Fascinating	.....	Routine
		.....	Satisfying	.....	Boring
		.....	Good	.....	Creative
		.....	Respected	.....	Hot
		.....	Pleasant	.....	Useful
		.....	Tiresome	.....	Healthful
		.....	Challenging	.....	On your feet
		.....	Frustrating	.....	Simple
		.....	Endless	.....	Gives sense of accomplishment
b.	**Supervision.**	.....	Asks my advice	.....	Hard to please
		.....	Impolite	.....	Praises good work
		.....	Tactful	.....	Influential
		.....	Up-to-date	.....	Doesn't supervise enough
		.....	Quick tempered	.....	Tells me where I stand
		.....	Annoying	.....	Stubborn
		.....	Knows job well	.....	Bad
		.....	Intelligent	.....	Leaves me on my own
		.....	Lazy	.....	Around when needed
c.	**Promotions.**	.....	Good opportunity for advancement	.....	Opportunity somewhat limited
		.....	Promotion on ability	.....	Dead end job
		.....	Good chance for promotion	.....	Unfair promotion policy
		.....	Infrequent promotions	.....	Regular promotions
		.....	Fairly good chance for promotion		
d.	**Co-Workers.**	.....	Stimulating	.....	Boring
		.....	Slow	.....	Ambitious
		.....	Stupid	.....	Responsible
		.....	Fast	.....	Intelligent
		.....	Easy to make enemies	.....	Talk too much
		.....	Smart	.....	Lazy
		.....	Unpleasant	.....	No privacy
		.....	Active	.....	Narrow interests
		.....	Loyal	.....	Hard to meet

Again thank you for your time and co-operation.

APPENDIX 3 TO

MASTER'S THESIS

FOLLOW-UP ROSTER DESIGN MAIL SURVEY QUESTIONNAIRE

(To be completed by OIS SHIFT WORKERS only) /

(To be completed by OIS NON SHIFT WORKERS only)

Introduction

There are many factors to be considered when designing a shift working roster. Research in the past indicates that the following criteria will have some impact on the shift working roster and that they should be considered to a varying extent when designing a shift working roster.

To enable me to explore roster design in depth would you please rate the following Roster Design Criteria by indicating their relevant importance to you personally. Please circle the appropriate response where **3 = Very Important**, **2 = Important**, and **1 = Not Important**.

Thank you for your support in completing this survey.

Peter Bryar

ROSTER DESIGN MAIL SURVEY

Serial	Roster Design Criteria	Very Important (3 Points)	Important (2 Points)	Not Important (1 Point)
1.	The shift roster should have few nights in succession.	3	2	1
2.	The morning shift should not commence too early.	3	2	1
3.	The shift change times should be flexible.	3	2	1
4.	The length of shift should depend on the physical and mental load of the work.	3	2	1
5.	The night shift could be shorter than the day shift.	3	2	1
6.	Short intervals between two shifts should be avoided.	3	2	1
7.	There should be some free weekends including at least two successive days off.	3	2	1
8.	The shift roster should be regular (no changing from roster to roster or crew to crew).	3	2	1
9.	Rosters should be predictable so that you can plan ahead.	3	2	1
10.	Rotating shifts should rotate in a phase delay sequence (eg. morning to evening to night to morning).	3	2	1
11.	Fixed shifts should be considered.	3	2	1
12.	Avoid calling shift workers in on their days off.	3	2	1
13.	Allow for, and if possible, provide for naps to be taken during the night.	3	2	1
14.	Shift workers should choose the roster they are to work under.	3	2	1
15.	Enhancing the internal and external communication systems to prevent isolation.	3	2	1
16.	Conducting training throughout the shift cycle and not just on day shift.	3	2	1
17.	Allowance for transport and travel times to and from the place of work.	3	2	1
18.	Offering of benefits such as more time off, extra recreational leave, facilities etc.	3	2	1
19.	Structuring work load so that the shift crew can choose when they will be done.	3	2	1