THE AGING WORKFORCE: PERSPECTIVES AND IMPLICATIONS

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Abstract

In many industries, there has been an increasing trend for the workforce to become older due to better health and longevity, and because younger people are not being attracted to industries.

Aging brings new challenges with respect to the context and requirements of work and has been the subject of several reviews on the status and promotion of work ability, employability and employment of workers over 45 years of age.

The Australian mining industry is no exception to this trend. As such there is a need to consider the implications of the change and to identify strategies with emphasis on the potential benefits in maintaining the skills and experience characteristic of the older worker, while minimising any negative consequences such as injury risk.

There is little information of specific issues associated with aging workers in the mining industry, therefore this paper will review related information from overseas, including mining and other related industries.

The physical and psychological changes which occur with aging, will be presented as a basis for discussion of the implication of these changes with respect to areas such as health, education and expertise, and work conditions and demands.

The potential for job redesign, fitness for duty measures in the broader context, work ability, and injury prevention and rehabilitation will also be considered.

The discussion will also focus on changing work patterns, shiftwork, and irregular hours, and the implications of these changes for older workers.

Issues including tolerance to shiftwork and identification of organisational changes which may improve or weaken work ability and functional capacity will be addressed.

Older persons have been shown to have considerable capacity to maintain and enhance their functional capacity, but there remains a need to identify the more effective worksite programs which may be used to evaluate, monitor, and improve functional fitness.

At this time, knowledge of issues associated with aging in mining is limited and mainly derived from overseas sources. Consequently, there is a need for research which provides comparative data on the epidemiology, and health profile of the older worker in the Australian mining industry.

Investigation of health indicators, accident profiles, physical work environment, physical and mental demands and work hours in relation to age is also a priority. Information derived from these investigation would be useful in designing and evaluating of worksite interventions

1. Introduction

Aging workers will characterise the Australian labour force until 2016. Australian data indicates that nearly 30percent of the population will be 55 years and over by 2016 [Australian Bureau of Statistics (ABS), 1999].

The Australian population is aging due to the baby boom following World War II (WWII), an increase in lifespan, and a slowing of the birth rate from the 70s onwards.

Those aged 55 and over accounted for 10 percent of the Australian labour force in 1998.

However, this age group is expected to account for half of all the growth in the labour force in the near future. In 1998, the 60-64 years age group accounted for less than 3percent of the labour force, yet this group is expected to account for 15percent of the total labour force growth between 1998 and 2016 (ABS, 1999).

The steady increase in the average age of the Australian work force will have wider social and economic consequences, as well as impact on the workplace setting (ABS, 1999).

The aging of the Australian population is in line with international trends. A United Nations (1996) review of worldwide trends shows by the year 2030, 20 percent of the population will be 65 years and older.

Employers, especially large corporations, have historically reacted to depressed economic times by offering early retirement to older workers in an attempt to cut costs.

Quite often attitudes to older workers may be driven by employers perceptions that older adults are less physically and mentally competent, that their productivity levels are lower, and their accident potential is higher than younger workers.

Thus, the early departure of older highly experienced workers leaves a large gap in the resource levels of organisations.

Organisations tend to overlook the positive benefits in relation to older workers, such as, the substantial work and life experiences which enhance overall capabilities and provide significant advantages in many jobs (Spiruduso, 1995).

Therefore, the purpose of this paper is to identify those physical and psychological factors which characterise the older worker, and to discuss the implication of those to industry.

These factors will be considered in relation to workload demand and the risk of injury. Additionally, intervention and management strategies including health and fitness issues associated with an aging workforce will be discussed. Where possible, implications with respect to the Australian mining workforce will be addressed.

2.0 Changes with aging

2.1 Physiological

An increase in age coincides with physiological body changes, which can cause decrements in physical and mental functional capacity.

Physical changes that accompany aging include a decline in aerobic power and endurance capacity. This capacity can decline by 25percent in men and women after the age of 25 years and these changes are strongly associated with aerobic exercise, or lack of it.

Changes in musculoskeletal capacity can also be pronounced after the age of 45-50 years, and muscle strength can decrease 40-50percent over a ten year period (Ilmarinen, 2001). Declines in muscular strength and endurance occur first in the legs, followed by the trunk, shoulders, arms, and then hands (Kawakami & Inoue, 1999).

Decrements in functional capacity can lesson the aging workers' ability to cope with job demands and could place undue stress on workers, especially in occupations that require a high level of physical exertion such as mining.

It has been suggested that an over-taxing of the heart and the skeletal muscles may lead to a decrease in productivity. This decrease is due to an increase in worker fatigue, that in turn may result in absenteeism, accidents, industrial disputes, increased injury, heart attacks, and strokes (Shephard, 1999).

Another facet of aging is a diminished resistance to physical stress. Older workers are more susceptible to severe injuries resulting from body trauma, and recovery from severe injuries will tend to be slower with an increase in age (LaFlamme et al, 1996).

2.2 Psychological

Changes in mental functioning are associated with a decrease in precision and the speed of perception, involving the whole body.

Changes occur in the ability to process information and reflect alterations in the following systems: the sensori-perceptive system that is responsible for receiving information through the senses (eg sight and hearing); the cognitive system that processes the data from the senses and memory system; and the motor system that is responsible for the realisation of the decided functions (LaFlamme et al, 1996; Spirduso, 1995; Kawakami & Inoue, 1999).

2.3 Variability in the Aging Process

Aging is highly individual, deterioration of physical and mental capacities can start earlier in some people, and the rate of deterioration varies from person to person (Garb, 1991).

Thus, the functional capacity of what is considered to be the aging worker cohort (>45 years) can vary remarkably. For example, it could include a 50 year old worker that has the functional capacity equivalent to the average 25 year old, or a 45 year old worker who may have the functional capacity equal to the average 80 year old.

Therefore, there are some older workers that will have greater physical and mental functioning than some younger workers.

Because of the large variability in capabilities and rate of physical decline with aging it is important that strategies to manage the older worker are targeted at an individual level.

For strategies to be properly implemented it must be possible to estimate functional capacity based on three factors: physical capacity, mental capacity, and social function. In addition techniques for estimating psychological factors such as work satisfaction and attitude, will allow for the fullest estimation of functional capacity and predisposition to injury (Kumashiro, 2000).

In terms of the variability of the aging process the implications for the mining industry are complicated by inter-individual differences in the energy cost of specific tasks and the work structure of a typical day, including shiftwork. Importantly, a potential consequence could be an increase in age related accidents (Shephard, 1999).

3.0 Injury and aging

While many organisations perceive that older workers experience a greater injury potential than their younger workmates the literature is inconclusive on this issue.

3.1 Higher or Lower Injury Risk

A study of age-related risk of occupational accidents in iron-ore miners (LaFlamme et al, 1996) revealed that the accident rate of older miners was not greater but rather lower than their younger co-workers. This finding is consistent with previous injury results in older miners (LaFlamme & Menckel, 1995).

Likely explanations for these findings have been proposed. Firstly, older workers are possibly not exposed to as many accident risks, taking on what could be considered as less physically demanding jobs than their younger co-workers (LaFlamme et al, 1996).

Secondly, older miners may make use of compensatory skills when performing their occupational tasks. That is, the tasks undertaken might be 'age-counteracted' rather than 'age-impaired' (Warr, 1993).

Finally, older workers who find that they are no longer mentally and physically capable of meeting job demands, leave demanding and hazardous jobs. This departure could result in a group of older workers with a relatively high work capacity (LaFlamme, 1996).

Warr (1993) has suggested that performance is the combination of three different factors: physical ability, adaptiveness, and general work effectiveness. While physical ability and adaptability tend to both decline with age, general work effectiveness might remain stable or even increase with age.

In contrast, a retrospective longitudinal study (LaFlamme et al, 1996) indicated a substantial increase in accidents that can be presumed to be more frequent in older workers. In older workers, the lower back appears to be at greater risk of injury from falls and missed steps, as well as from overexertion causing sprains and strains.

This result is in line with previous research showing simular causes of lower back injuries in older miners (Hull et al, 1996). Maximum ability in trunk flexion and extension has been known to decrease 40-50 percent within 10 years in those aged more than 40 years working in physically demanding jobs (Ilmarinen, 2001). This would explain the predisposition to lower back injuries in older workers.

3.2 Mining, Aging, and Injury

The relationship between the nature of injury, injury mechanisms, recovery, and aging in the mining industry has been explored by several research groups. Hull et al (1996) examined lost time incidents (that were non-fatal), involving one or more lost working days, occurring in underground mines. Injuries involving travel to and from work were not included.

Results indicated that older miners did not show a significantly greater frequency in injury rates. However, injuries in older workers were more severe than in younger miners.

The relationship between age and severity may be due to loss of durability, making older workers more susceptible to energy impacts encountered in underground mines. This suggests that in older workers a given amount of energy may result in more severe injuries.

Recovery from injury may be age related, and studies have indicated that older workers may take longer to recover than younger workers for the same given injury (Hull et al, 1996; La Flamme et al, 1996).

Severe accidents (those that required 20 or more days recovery) constituted only 16 percent of all injurious accidents in underground mines. However, this type of injury resulted in 75 percent of the total days lost for the whole of the NSW underground coal mining industry.

Although older miners are not more likely to injure themselves, when they suffer an injury they are likely to be severely injured and require considerable time to recover (Hull et al, 1996).

Results of injury research (Fotta & Bockosh, 2000) showed with few exceptions, older injured workers have the highest median number of days lost per injury within the American Mining Industry.

Hull et al (1996) found that transport related activities, rather than equipment maintenance and metal/mechanical trades, accounted for the majority of severe coal mining injuries (predominantly involving the aging workforce).

The severity of injuries from transport related activities (driving vehicles) may be due to the large role of transport in the extensive mechanisation of underground coal mining operations.

This finding highlights the importance of modifying job and safety training programs in conjunction with changes in mechanisation.

Safety procedures in the mining industry today require a high level of awareness for fellow workers, and considerable skills. It is possible that the learning of these skills as a result of aging is not matched with the pace of mechanisation in the mining industry. The higher incidence of injury severity in older workers may in part, be due to inadequate knowledge of safety procedures and a lower technical ability related to technological change (Hull et al, 1996).

Hull's (1996) work also indicated injury severity was strongly associated with over exertion, fall of a person, and falling object/substance. These findings are comparative to a simular study that found overexertion, coal/rock slide/fall, and tripping resulted in much greater injury severity (VIOSH, 1994).

These mechanisms of injury are prime targets for preventative strategies and further research. What needs to be determined is the context in which these injuries are occurring, and if these injuries are the result of human error, equipment, or physical functioning (Garg, 1991).

Thus, as workers age there is a decrease in functional capacity, or ability to perform duties, that may predispose them to an increased likelihood of injury.

For industries such as mining an increase in the number of aging workers could impact on the already high injury incidence rates.

Nationally, the mining industry has the highest injury incidence rate (89 per 1000 workers) compared to the national average of (49.3 per 1000 workers) (ABS, 2002), and a greater number of workers' compensation claims than any other industry (Worksafe, 1999). It is possible that injury incidence rate, the number of days lost due to injury, and loss in productivity could be reduced if greater effort is targeted towards maximising employee health.

4.0 Shiftwork and aging

Almost all mining settings are 24 hour operations. While the duration and timing of shifts may vary from mine to mine, the impact of working around the clock on the mining workforce has the potential to increase fatigue and accident risk.

The effects of shiftwork are numerous but among the acute effects are increased fatigue and sleepiness, impaired job performance, and reduced and poor sleep; all of which increase with age (Heslegrave, 1998).

Partly as a result of circadian disruption, shift-workers are at risk of sleep deprivation, and both the quantity and quality of sleep may be affected.

Sleep disturbances and deprivation have been associated with poor health (Scott and Ladou, 1990).

The negative effects of shiftwork have been shown to increase in workers aged in their forties and fifties (Heslegrave, 1998; Reid and Dawson, 2001; Scott and Ladou, 1990).

Study results indicate that aging workers become intolerant of their work schedule, even though many have done shift work successfully for many years

(Heslegrave, 1998). Heslegrave (1998) surveyed shift workers to determine whether shiftwork had become slightly or much more difficult as they had grown older.

Survey results indicated that about mid 30 years of age, shiftwork became slightly more difficult. By 35-39 years of age, over 80 percent of shift workers reported some form of difficulty coping.

By 40-44 years of age, 80 percent of shift workers reported an increased difficulty in coping, with 40 percent reporting the increase in difficulty was more severe.

Reid and Dawson (2001) studied performance on a simulated shift rotation in young and older workers.

Their results showed that although the performance of the older workers increased during a 12 hour day shift, it was lower than the younger workers.

In addition, the performance of older workers significantly decreased across the night shifts, in contrast, to the younger workers who were able to maintain performance across both day and night shifts.

Heslegrave (1998) studied shift workers working their typical shift and found a decrease in arousal, increase in fatigue and sleepiness, and a 10-15 percent reduction in performance in aging workers when working an 8-hour night shift.

Thus, a further issue in relation to an aging workforce is the effects of shiftwork. Older miners not only undertake physically demanding tasks but also encounter added effects of shiftwork in mining.

5.0 Intervention and modification in industry

In general, the decline in physiological functioning of the aging worker has often been considered by companies to be a handicap.

Kumashiro (2000) explained that too much emphasis is placed on the decline in physical function of workers and very little or negligible attention directed towards the synergistic capacity of workers.

That is, the general capacity to perform tasks supported by a wealth of experience and knowledge.

The author suggested that this synergistic capacity should be utilised as much as possible to provide support for the declining physiological functioning.

5.1 Compensatory Strategies

Although functional capacity declines with age, and predisposes older people to more severe injuries, older employees have unique qualities that support their continued employability.

Older workers learn to replace uneconomical with economical responses and incorporate different strategies to compensate for physical skill decline.

Those who continue to work tend to maintain the level of physical skill necessary to complete tasks. In industry, older adults generally are more productive, have less absenteeism, have fewer accidents, and change their jobs less often than younger workers.

The greater an employee's skill, competence, and experience, the smaller the decline in productivity with advancing age (Spirduso, 1995).

5.2 Workplace Redesign

Aging workers can face problems at work that can lead to overload and stress (Haslegrave & Haigh, 1995). The main factors causing these are:

- working under pressure of time
- frequent changes in technological process
- high speed working
- the need to process large amounts of information rapidly
- continuous high level of vigilance
- heavy physical work
- poor environmental conditions
- night-time shift work.

The creation of working environments and settings that enable the aging worker to work in conditions of good health and safety is imperative.

A working environment that allows the aging worker to work within their capability serves to boost corporate productivity and efficiency.

A possible solution to the problem could be to move aging workers to less demanding jobs, such as supervisory roles, however, this option is not applicable to most situations, particularly in smaller organisations.

Job redesign to suit the individual worker is also possible but again may be impractical in smaller operations (Haslegrave & Haigh, 1995).

Netherless, it appears that the older worker would be disadvantaged in those workplaces where tasks are designed for the capabilities of the younger worker.

In some cases it may not be feasible to retrain the older worker as a solution to the problem. Training alone may not adequately compensate for the diminished work capacities of older individuals and some form of workplace modifications may be needed to compensate for, or better utilise, the diminished physical and mental capabilities of older workers (Garb, 1991).

Currently, limited research has been undertaken in the area of job redesign for older workers.

Therefore, it is difficult to make recommendations as to how the work environment should be modified to ensure maximum productivity and also protect the health of the older workforce.

As the impact of the aging workforce is only starting to take effect, there has been little interventional research on workplace modification. However, in Japan the issue of the aging workforce is a priority and a number of studies have looked at workplace redesign for this group.

The noodle manufacturing industry in Japan is composed generally of small to medium sized enterprises.

With the shortage of young labour, many companies have found it hard to employ young labour and have been compelled to employ a large percentage of aged workers in what can be considered very physically demanding occupations.

In an attempt to redesign jobs to better suit older workers Hasegawa & Matsumoto (1995) evaluated the effect of changes to working procedures and organisational systems in noodle making.

Changes included the elimination of manual lifting of raw material, and the placement of product inspection systems to ensure comfortable worker posture during this process.

The results were positive, indicating improved supervisory tasks, workload decreased, and productivity and efficiency.

Job redesign was also implemented in a plastic manufacturing company that predominantly employed middle-aged and older workers.

When the company was first designed consideration was not given for human engineering or labour physiology of the aging worker.

As a consequence of complaints from aging employees, employers found it necessary to develop better work practices. Many of the improvements were achieved through removal of the physical demands placed on aging workers as identified in the survey.

The employers did not attempt to replace the need for muscle strength with machines; the process was only partially automated. The changes enabled work tasks for middle-aged and older workers to better match their physical capacity, and resulted in enhanced worker productivity (Kimura & Kishida, 1995).

Evidence from Kumashiro and Masaharu (1999) revealed that in an ideal management situation the needs of aging workforce would be addressed.

However, despite the absence of the ideal workplace in most workplaces strategies such as assigning older workers to more appropriate tasks can be implemented without loss of productivity.

5.3 Detecting Cause of Injury

From evidence that aging may impact heavily on injury status further research is required to determine other causative factors pertaining to accidents.

For instance, human error rate in older workers resulting from equipment design, and the impact on productivity is yet to be determined. Similarly low productivity, low efficiency, and high injury rates at many workplaces can be attributed to either poorly designed equipment, workplaces, and/or environments (Garg, 1991).

A number of studies have been conducted to evaluate the best method of assessing workplaces to determine causes of injury, with the aim of implementing workplace redesign strategies that more safely include an aging workforce.

Ilmarinen (1992) highlighted that the first step to workplace redesign was to identify the source of the problem.

This would require that data collection processes be based on the age and health profile of the workforce, and should include information on worker ability, job demands, and the imbalance between work demands and worker capacity.

5.4 Matching Worker and Task

In most workplace settings job demands for the older worker remain unchanged. This situation continues despite information which suggests that the more unstable the balance between an individual's capacity and job's demands, the greater the risk of a wide range of undesirable outcomes, more specifically the greater the risk of occupational accidents (LaFlamme, 1996).

In a review of the changes in mental capacity with aging Garb (1991), indicated that the age of workers on a job could be related to the complexity of the task.

For instance, younger workers are considered by the author to be more suited to complex jobs that require greater perceptual demands and jobs that require extreme attention to detail or that make severe demands involving sustained care and concentration.

In contrast, older workers may cope more effectively with slower paced mental and physical tasks.

Evaluating the physical demands of jobs is important in assessing worker-job compatibility, and a specific jobs analysis needs to be performed to determine:

- the tasks that are required by each specific job
- the physical, mental, and physiological characteristics necessary to perform the tasks.

The next step is to determine which job related tasks should be simulated in a worker task test.

This assessment should consider the frequency of the task, the critical role of the task in the job, and the skill levels required. The development of tests assessing physical capacity in relation to demands can be utilised as part of employee medical assessment (Davis and Dotson, 1987).

Job assignment can be adjusted by employers, so that older workers can work in self-paced predictable jobs that put a premium on coordination and dexterity rather than strength and endurance (Kumashiro & Masaharu, 1999).

Ergonomics researchers have suggested many equipment and workplace design modifications can be made to adjust for age related deficits.

For example, to minimise problems with attention span, irrelevant details on control panels and switches can be eliminated or masked. To compensate for visual losses, illumination of the task can be increased, the contrast between letters and background can be magnified, and highly contrasting colours can be used on instrument panels (Spirduso, 1995). T

To maximise work performance adjustments to enhance the workplace environment for older workers with reference to their age related physiological and psychological changes should be implemented and a summary of an age/task matching process is shown in Table 1 (Spirduso, 1995).

6.0 Health maintenance

Although job redesign may be considered impractical in some operations, programs to monitor and optimise the health and fitness of the older worker can be implemented with beneficial outcomes for worker and employer.

Health promotion programs in the workplace however may have limited success particularly when such programs lack management support. Cooperation between workers and management is critical to the success of the program, together with

Table 1. Modifications to enhance workplace environment for aging workers. (Spirduso, 1995).

Age related changes	Workplace/environmental adjustments
Decreased joint mobility Reduced elasticity of tissues	Avoid jobs that require or have - elevated arm activities - prolonged unusual postures - large wrist deviation to apply force using tool Position objects, controls, displays to minimise prolonged flexing, bending and stooping Adjust furniture to individual anthropometry - seats in vehicles - office furniture Design seats to reduce vibration - low frequency vibration (truck earth moving equipment, mining) - large wrist deviations to apply force using tools
Loss of strength	Avoid - controls and tools that require high strength - lifting, lowering, pushing, pulling, bearing loads - lifting loads >20percent maximum of young workers - lifting rapidly Design tasks so that - load is kept close to body - task does not require bending, stooping, or twisting - adequate rest is provided between lads - task assures good foot traction Teach workers correct mechanics of lifting and pushing
Reduced work capacity	Jobs requiring energy expenditures should not exceed 0.7 (men) or 0.5 (women) L/min oxygen consumption
Slowed perception and decision making Attention deficits Memory deficits Difficulty with mental transformations	Provide - longer training sessions - practice with written instructions - videotapes of desired performance - increased signal to noise ratio Assign older workers to - tasks which work is previewed rather than reacted to - tasks that are predictive rather than novel
Visual deficits	Provide - 50percent more illumination for workers 40-55 years - 100percentmore illumination for worker > 55 years
Acuity	- increased task contrast on control panels, writing on labels - increased display letters and symbols - reduced glare
Colour discrimination (blue/green)	Omit blue/green discrimination
Less tolerance for heat	Reduce heat stress index in workplace
Less tolerance for cold	Maintain optimum worksite temperature
Hearing loss	Increase signal to noise ratio in tasks that provide audible cues or instructions
Greater incidence of low back pain (LBP)	Provide job training to prevent LBP - risks on job - basic knowledge of body mechanics - specific motions to avoid - planning job activities to minimise back stress - of-the-job injury prevention
Increased risk of falling	Eliminate slippery walkways Mark steps or ramps Illuminate workplace adequately
Slower rehabilitation from injury or disease	Allow more gradual return to full work load Allow rotation between light and heavy jobs to phase in work requirements Provide information regarding proper rehabilitation and return to work Avoid paced work
Tendency toward inactivity	Give worker control over work load Emphasis accuracy rather than speed Provide fitness programs Encourage employees to use fitness programs

The role of physical activity for maintaining work ability during aging was evident in a 10-year follow-up study of aging municipal employees.

Deterioration and improvement in work ability was assessed in a sample of subjects aged from 51-62 years.

An increase in brisk physical training at least twice a week was one of the three most powerful predictors of improved work ability during the 10 years.

However the decline in brisk training was one of the four most powerful predictors of decreased work ability during the 10 years.

The effects of physical activity on work ability were independent of work type (physical, mental, or physical-mental work) and gender (Ilmarinen et al, 1997).

A randomised trial comparing physically active adults aged 35-60 years to sedentary adults of the same age found that over the period of two years there was no decline in average work ability in the active adults; however, there was a decline in the sedentary groups (Smolander et al, 2000).

Research indicates that adults who regularly participate in physical activity can maintain superior muscular endurance for many years, an accomplishment that enables them to continue working.

One of the clearest findings in the literature on strength and aging is that disuse accelerates aging. Most of the decline seen in strength and muscular endurance, at least to the age of 70 is due more to disuse of the neuromuscular system than to aging (Spirduso, 1995).

6.3 Injury Rehabilitation

Although older workers recover from injury more slowly than their younger counterparts, the number of days lost due to severe injury may be reduced if they are educated on the importance of early participation in rehabilitation programs.

Lustead (1993) found that although return to work took longer for older workers with back injuries the time could be significantly reduced if the worker was referred for rehabilitation without delay.

Emphasis on immediate rehabilitation and training in safe working practices for mine workers experiencing all types of injury, especially the knee, multiple site, and back injuries, should be an aim of any strategy to prevent severe injuries and/or control the severity of injuries (Hull el al, 1996).

It is recognised that all miners will not necessarily have access to the most effective treatment regimes, thus making injury prevention strategies critical to reduction of the personal and social cost of injury.

7.0 Conclusion

Research indicates that older workers will dominate the Australian workforce during the next decade.

The Australian mining industry is no exception to this trend and new strategies are required to maximise utilisation of the experience and skills of the older worker, while at the same time reducing the risk of injury.

Such strategies might include job redesign, more effective matching of physical and mental capability with job and task demands and specific health appraisal and fitness programs.

Further research is required in the mining industry to identify the needs and injury profiles of older workers and to assess the efficiency of current strategies to support the older worker. Additionally, intervention studies are required to examine the potential for job redesign, fitness enhancement, and their relationship to productivity and health related issues.

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