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Older construction workers : a study of related injuries, underlying causes and estimated costs

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OLDER CONSTRUCTION WORKERS – A STUDY OF RELATED INJURIES, UNDERLYING CAUSES AND ESTIMATED COSTS

By

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A DISSERTATION PRESENTED TO THE HIGHER DEGREES COMMITTEE OF THE CAPE PENINSULA UNIVERSITY OF TECHNOLOGY IN FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF TECHNOLOGY IN CONSTRUCTION MANAGEMENT

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DECLARATION

I, Marius Eppenberger, declare that the contents of this dissertation represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

	18 November 2008
Signed	**Date**

DEDICATION

This work is dedicated to my Mom who instilled into me from a young age a sense of self-development through encouragement and investigation of the written word; to my Dad who worked long hours of overtime to give ‘us children’ a good education; and to my wife and soul mate who shares the same sense of work ethic and dedication required to complete a study of this nature.

The work is also dedicated to all the construction workers who provide the lifeblood for the construction industry and allow for the ongoing development of mankind. These workers are placed in the frontline, operating under adverse site conditions, exposed to the ever-present risk of injury, and all for a meagre life sustaining wage.

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This study would not have been possible without the valuable input of the construction workers and construction managers approached.

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The financial assistance of the National Research Foundation towards this research is acknowledged. Opinions expressed in this thesis and the conclusions arrived at, are those of the author, and are not necessarily to be attributed to the National Research Foundation.

A close relative once said to me that by the age of forty, one must either be a millionaire or hold a Masters degree.

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LIST OF ABBREVIATIONS

BLS	U.S. Bureau of Labour Statistics
CBI	Confederation of British Industry
CFOI's	Census of Fatal Occupational Injuries
CIB	Construction Industry Board
CIDB	Construction Industry Development Board
CII	Construction Industry Institute
COID Act	Compensation for Occupational Injuries and Diseases Act, 130 of 1993
CPWR	Centre to Protect Workers Rights
ELCOSH	Electronic Library of Construction Safety and Health
FEM	Federated Employers Mutual Assurance Company
HSE	Health and Safety Executive
NEPAD	New Partnership for Africa's Development
NIOSH	National Institute of Occupational Safety and Health
OHS Act	Occupational Health and Safety Act, 85 of 1993
OSHA	Occupational Safety and Health Administration
RSA	Republic of South Africa
U.K.	United Kingdom
U.S.A / U.S.	United States of America / United States
WCA	Workman's compensation assurance
WHO	World Health Organisation

ABSTRACT

Abstract of Dissertation Presented to the Higher Degrees Committee of the Cape Peninsula University of Technology in Fulfilment of the Requirements for the Degree of Master of Technology in Construction Management

THE OLDER CONSTRUCTION WORKER – A STUDY OF INJURIES, THEIR UNDERLYING CAUSES AND ESTIMATED COSTS

By

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The construction workforce in South Africa is one that is ageing. This is a global phenomenon and necessitates research into how the older cohort of the construction work force can be optimally engaged. Optimum worker productivity, high quality products that meet the specifications required, and high levels of occupational safety and health are integral factors in achieving a sustainable workforce.

The purpose of the research was to quantify the injury rates among older construction workers as well as to determine the events leading to these injuries, the nature of the injuries and the bodily locations affected. The costs associated with these injuries were investigated to understand whether there were any discernable differences between injuries to older and younger workers. Apart from the literature review, two statistical construction injury databases were analysed. Qualitative questionnaire based interviews were designed to gather information related to older construction workers. Questionnaires were sent to construction site managers to gauge their perceptions of older construction workers. The statistical data was collected from the Western Cape region and was for the period 1998 through 2005 while the interviews and questionnaire data were collected during 2008.

The potential benefits to industry are a consolidation of injury information relating to older construction workers. This should assist construction managers with developing policies and implementing strategies to prevent or at least minimise injuries and minimise the related costs, with the aim of more effectively utilising their older workers and ultimately achieving a more sustainable construction industry.

The study found that older workers sustained less injuries in total compared with younger workers. No discernable variances occurred between younger and older workers when it came to events leading to injuries (causes) and the type/nature of injuries. It was, however, found that for the body parts affected, older workers were more prone to certain injuries. Older workers sustained less severe injuries compared with their younger counterparts but the injuries were more costly. The research findings supported the notion that older workers receive less training than younger workers.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Globally, the construction workforce is reportedly one that is ageing (Arndt *et al*., 1996; Schaefer, 1998; Walker and Taylor, 1999). This 'ageing' is attributed to changes in demographics and a loss of interest among young people in a career in construction leading to an increase in the proportion of older construction workers (Arndt *et al*., 1996). South Africa's Minister of Social Development, Dr. Skweyiya (2002) pointed out that global ageing is unavoidable and will impact on South Africa.

For there to be any chance of utilizing older construction workers optimally, it is important to understand the stressors that they face on a day-to-day basis. By improving their personal well-being, productivity, job quality and site safety will also benefit. The accident rates and types of injuries suffered by older construction workers may hold some clues to the types of stressors and strains they experience. It is generally accepted that for a workforce to be productive it must ultimately be one that is healthy (NEPAD, 2001). South Africans are in the process of building a sustainable workforce that will allow economic growth and sustainability. To achieve this objective as required by South African law, a safe, healthy and productive workforce is needed (OHS Act, 1993).

Conditions on construction work sites are not attractive enough to younger workers. They are exposed to adverse weather and climatic conditions, noisy and dusty, inherently dangerous work environments that are physically demanding (Coble *et al*., 2000). The impression of the industry is one that is fragmented and disorganised and one that does not offer sustainable and continuous employment to its workforce (Coble *et al*., 2000). The technical advancements are comparatively slower than most other industries. Further, the accident, injury and fatality rates in construction are higher than most other industries (Coble *et al*., 2000; Schaefer, 1999; Hinze, 1997; Khalid, 1996). Therefore, industry role players need to find ways to manage older workers effectively while also addressing the apparent negative perceptions of construction held at large so as to attract young people to pursue careers in construction.

Further, several authors argue that the issue of poor safety and health performance accompanied by high rates of accidents, injuries, occupational health conditions and diseases among construction workers is of great concern (Everett and Frank Jr., 1996; Vargas *et al*., 1996; Khalid, 1996; Hinze, 1997; Coble *et al*., 2000). For example, the National Safety Council (NSC) in the United States (U.S.A.), found that in 1991 construction injuries accounted for nearly 11% of all work injuries and more than 30% of all work related fatalities (Vargas *et al*., 1996). Research suggests that serious occupational injuries involving death or disability increase with age while less serious injuries decrease (Zwerling and Sprince, 1996; Stalnaker, 1998; Patrickson and Hartmann, 1995). In addition, the older worker generally takes longer to recover from his or her injury, resulting in the cost per injury increasing. This may be attributed to the pre-existing physical condition of the older worker and/or the injury being more serious in nature (Stalnaker, 1998; Patrickson and Hartmann, 1995). Injury costs among older workers need to be quantified with the aim of convincing Employers that poor safety and health impacts negatively on their bottom-line and that improved worker protection plans may be the answer to improving profitability (Coble *et al*., 2000; Hinze, 1997). McCann and Chowdhury (2000) found that falls from ladders composed 60% of all fall related injuries that occurred to workers aged 44 years. This research finding suggests that balance and body weight may have been causative factors leading to the high percentage of falls from ladders among this age group. Other factors that may lead to a higher risk of injury are poor eyesight and poor hearing (Patrickson and Hartmann, 1995). When employers conduct job hazard analyses they should identify the risks most likely to cause injury to older workers and devise control measures accordingly.

Evidently certain population sub-cultures may be at higher risk to occupational injuries and potential fatalities then others. Workers in these higher risk groups are often not conversant with the common language spoken on construction sites and are therefore not able to understand instructions and information given. Dooley (2002) found that employment of Hispanic workers in the U.S.A. was up 6% in the year 2000 compared with the previous year. However fatal injuries among Hispanic construction workers had increased by 24% for the same period. Many of these workers did not speak English well or at all suggesting that they were not able to understand safety and health related instructions given as well as other safety information. In South Africa there is a similar problem. Migrant workers, the vast majority being Black

Africans have a lower level of literacy than the average worker. Fuller, Liang and Hua (1996) found that the older the worker, the lower the level of literacy because of lower average levels of education in the past. The lower the level of education, the higher the risk of injury (Zwerling and Sprince, 1996).

Chiu and Ngam (1999) found that older workers in Hong Kong were more likely to hold unskilled jobs and were earning less than their younger counterparts. Older workers were therefore forced to work until they were even older to achieve an acceptable pension, leaving young workers with fewer job opportunities (Chiu and Ngam, 1999). It is also important to note that extended working hours, overtime and shift work are seen to negatively impact on safety and health and are causes for an increase in accidents and injuries (Sparks *et al*., 1997; Duchon and Smith, 1993; Laundry and Lees, 1991). This is just another example of possible injury causation among older workers that requires investigation.

Training is believed to be at the centre of all successful economic models. It improves work performance and efficiency and should therefore be a critical facet of construction management (Harvey *et al*., 2001). In fact, as far as high-risk industries are concerned, health and safety culture has a vital role to play. Training plays an integral part in changing health and safety culture (Cooper, 1995). Patrickson and Hartmann (1995) found that older workers received less job skills and less safety and health training than their younger co-workers. Less training has been found to lead to higher accident rates (Cooper, 1998). Construction companies that conducted the least amount of safety and health training experienced the highest accident rates (UK Training Agency, 1989). This suggests a negative or inverse relationship between safety and health training and accident incidence. In other words, construction companies need to invest in training their older workers if they want to reduce their current accident rates.

Older workers hold experience and knowledge that is critical to the construction industry. Anecdotal evidence suggests that the industry is not doing enough to retain older workers while on the other hand it complains about the loss of skills. This study seeks to develop interventions and management programs to assist construction employers to manage their older workers more effectively and efficiently in order to improve production, quality, health and safety.

1.2 Problem Statement

Older construction workers are a valuable source of experience and skills and are exposed to a wide range of hazards leading to injuries that cost the industry millions of rands every year.

1.3 Hypothesis

The following hypotheses will be tested:

1.3.1 The prevalence of work related injuries is higher among older construction workers compared with younger workers.

1.3.2 Certain injuries are more likely to occur to older workers.

1.3.3 Injuries sustained by older construction workers are of a more serious nature compared with younger workers.

1.3.4 The cost of injuries is higher among older construction workers.

1.3.5 Older construction workers receive less training compared with their younger counterparts.

1.4 Objectives

The purpose of this study is to investigate the specific issues that affect the safety and health of older construction workers. Certain injuries may be specific to older workers and must be investigated with the aim of minimising them as far as possible to ensure sustainable development in construction. This study has four primary objectives:

The first objective is to determine what construction work related injuries are more common among older workers in terms of in particular; the trades most affected, the events leading to the injuries, the nature of the injuries, and the body parts affected.

The second objective is to examine the relationship between the severity of the injuries sustained by construction workers and their age to establish what tasks should be avoided by older workers.

The third objective is to establish the nature of the relationship between injuries to older workers and their consequent direct and indirect costs with the aim of convincing Employers that improved worker protection programs should be implemented to reduce injury costs.

The fourth and final objective investigates the relationship between lower literacy levels, education and the likelihood of injuries sustained by older construction workers so that improved target related safety and health training may be implemented.

1.5 Methodology

The research approach to be followed will include a combination of qualitative and quantitative methodologies. These will include the following:

1.5.1 A comprehensive review of the literature relevant to the topic with particular focus on previous research to identify the factors that influence the likelihood and severity of injuries to older workers;

1.5.2 Sourcing available and relevant existing statistical data relating to construction injuries from various databases;

1.5.3 Personal interviews with construction workers of all ages to ascertain qualitative, descriptive data including: demographics; literacy and education; injuries sustained; training, etc.;

1.5.4 Questionnaires aimed at construction site managers with the aim of investigating their perceptions of older construction workers;

1.5.5 Statistical analysis of all collected data to identify trends, probabilities and severity of potential injuries to older workers;

1.5.6 A comparison of findings relative to the literature reviewed; and

1.5.7 Formulation of appropriate interventions.

1.6 Limitations

The study will be subject to the following limitations:

1.6.1 The research project was started in July 2003, was put on hold due to personal reasons and was restarted in January 2008 running through to November of the same year.

1.6.2 The research will be confined to data gathered from the construction industry in the Western Cape concentrating on construction workers over the age of forty years. Most of the research work previously conducted indicates that forty years and over is a reasonable indication of an older worker. Due to the nature of the industry, it was not possible to use experience as a criterion due to such problems as broken service or service with more than one construction company where accurate records are most often not kept.

1.6.3 The following categories of construction workers will be investigated, namely; carpenters, bricklayers, plasterers, painters, roofers, concrete hands and general construction workers as they are typically exposed to construction related hazards on a daily basis in the normal expectations of their job tasks.

1.7 Assumptions

The study is based on the assumptions that the various databases selected will be readily accessible and the data will be accurate, reliable and sufficiently detailed; and the responses to questions in questionnaires and interviews will be accurate and truthful.

1.8 Ethics

To comply with internationally accepted ethical standards, no names of individuals or organizations will be recorded on research instruments unless where expressly permitted. In this way no individual or organization will be linked to a particular completed research instrument, thus assuring anonymity. No compensation will be paid to any respondents for participation in the study. As with other studies quality assurance will be done with respect to the following aspects:

1.8.1 General conduct and competence of interviewers;

1.8.2 Correctness and completeness of questionnaires where used, especially where open ended questions are concerned;

1.8.3 Quality of data capturing done by encoders; and

1.8.4 Frequency distributions will be run to check that all variables contain only values in the accepted range and variable labels.

1.9 Definitions

Accident:	An unplanned, undesired event, which results in physical harm and/or property damage, usually from contact with a source of energy above the ability of the body or structure to withstand it. (Holt, 2001). An accident is an unplanned and unexpected event that causes injury or illness. (Haupt, 2001).
Construction trades:	Jobs tasks in the construction industry require different skills. These skills are divided into various trades: concrete work; carpentry; bricklaying; plastering; roofing; tiling; plumbing; electrical; and general construction work.
Culture:	A learned set of values that may take the form in an organization of practices interpreted through rules and norms of behaviour. (Hofstede, 1991).
Direct injury costs:	These are accurately quantifiable costs attributed to an injury. Examples include: ambulance service; medical treatment; medication; hospitalization; disability benefits; and lost wages of injured person/s; workman's compensation insurance costs. (Hinze, 2006).
Employee:	Any construction person working for a construction organization whether full time, part time, on salary staff, hourly paid, on contract, or any other method of employment.
Fatality:	An injury resulting in loss of life.
General worker:	A worker who carries out unskilled general construction related tasks.
Hazard:	Something that has the potential to cause harm.

Health:	A state of complete physical, mental and social well-being, and not merely the absence of disease or injury.
Incident:	An accident that did not result in an injury.
Indirect injury costs:	These are hidden costs that are not directly accounted for and not attributed to the injury. Examples include a drop in productivity of the injured person as well as work team, transport for treatment, employment of temporary worker/s, investigation time and costs, telephone calls, damage to equipment and materials. Unlike direct injury costs, these costs cannot be accurately quantified. (Hinze, 2006).
Injury:	For the purpose of this study an injury is a consequence of an accident causing a person to suffer a negative physical outcome. Injuries are bodily impairments that are immediate, occur at a fixed time and place, resulting from accidents. (Haupt, 2001).
Older construction worker:	A worker over the age of forty years. (Smallwood and Haupt, 2003).
Risk:	The probability or likelihood that harm will result in a particular situation coupled with the measure of the degree of severity of the harm or simply the probability of an adverse effect to human health. (Haupt, 2001).

1.10 Structure of the Study

The dissertation will be structured as follows:

Chapter 1: Introduction. This introductory chapter outlines the research problem and sets out the objectives of the research.

Chapter 2: Older worker injuries. This chapter will review the types of injuries typically suffered by older construction workers.

Older worker injury costs. The relationship between injuries and costs will be reviewed as well as whether there is a link between age and cost. A background to injury causation and the resultant costs of injuries will also be investigated as the basis for the research.

Chapter 3: Methodology. The method of gathering meaningful data is discussed in this chapter.

Chapter 4: Analysis and interpretation of the data and comparison with the literature study.

Chapter 5: Summary, conclusions and recommendations.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The construction industry differs from most other industries in that it is constantly in flux. Working conditions are very seldom the same from one day to the next, posing many challenges to the workers. The construction industry is considered to be dangerous and of a highly hazardous nature (Hinze and Olbina, 2008; Haupt, 2001; Rowlinson, 2000). Globally the construction industry has one of the highest injury rates, very often second only to the mining sector (Hinze, 2006).

When investigating injuries, the events leading to the injuries, the nature or type of injuries occurring and the body parts affected are important in ascertaining what measures should be implemented to reduce the injury rates. Further, injuries in the construction industry may show certain age specific characteristics.

In this chapter, construction injuries in general will be discussed with specific emphasis placed on the types of injuries sustained by older workers as well as the underlying causes of these injuries. The definition of older construction worker for the purposes of this dissertation is: a worker over the age of forty years (Smallwood and Haupt, 2003)

2.2 The construction industry

The construction industry is closely linked to the economy of a country and is often a good indicator of the state of that economy (Strassman, 1975; Turin, 1969). The Construction Task Force (1998) indicated that the construction sector in the UK projected an economic output of $87 billion in 1998. This constitutes 10% of GDP (Haupt, 2001). In China, the economy has been growing since 1979. The construction sector mirrored this growth (Ahmad and Yan, 1996). The South African economy has been experiencing consistent growth over the last eight years since 2000 with the construction sector playing an important role in this growth. In Europe the construction sector employs in the region of 7.5% of the total workforce (Haupt, 2001). If the construction sector and the economy of a country are so closely linked then it makes sense to effectively manage the human resources active in that industry.

It is also worth noting that a large proportion of the construction industry is informal in nature, which is very much the case in the South African environment, where less than 50% of the workforce is formally employed (Haupt, Deacon and Smallwood, 2005). The size of this part of the construction workforce is often difficult to quantify and is usually not included in statistics. It is therefore fair to say that the construction industry in fact supports a larger portion of a country's workforce than is portrayed in statistics.

No two construction sites are the same even though the physical structure being built may be very similar. The working environment, programme, sequence of construction and workforce will invariably differ. Weather conditions, location, physical conditions, and height constantly change (Haupt, Deacon and Smallwood, 2005; Porteous, 1999). Unlike manufacturing and other factory orientated work where conditions remain similar every day and where the workforce is the same, construction does not allow continuity of production since each product is unique (Haupt, 2001). This constant change means that construction workers are often faced with unfamiliar situations and are required to find effective solutions to unique problems. Very often these solutions are outside the bounds of recommended methods leading to an increase in health and safety risk (Toole, 2002).

Another negative factor influencing the management of health & safety during the construction process is one of fragmentation, meaning that there are many role players taking part in the process all with different roles, goals, expertise and skills (Haupt, 2001). Fragmentation may have the following results:

- Increased construction costs;
- Lowered productivity;
- Poor, ineffective communication between role players;
- Increased, and often unnecessary, confusing and contradictory documentation;
- Ineffective and inefficient project management;
- Unnecessary time delays;
- Unsatisfactory quality performance;
- Re-work;
- Poor levels of safety and health; and
- Costly, lengthy disputes (Haupt, 1996).

The role players involved in the construction process include the owner or developer, typically termed the client, the various design professionals, the principal contractor(s), sub-contractors and even sub-sub-contractors, all with different duties and responsibilities. Historically, it was the contractors who were solely responsible for worker health and safety (Occupational Health & Safety Act, 85 of 1993). This led to a progressive lack of interest and lack of knowledge by design and project management teams into the importance of worker health and safety. The balance has now shifted in South Africa with the advent of the Construction Regulations (July 2003). This set of regulations, following on the Construction Design and Management Regulations (1995) in the UK, makes the designer, the construction client and other professional parties responsible for the safety and health of workers on construction sites. Arguably, this development should lead to more responsible construction processes and more realistic targets and deadlines and ultimately a reduction in incidents, injuries and ill health.

The global demographic shift towards an older population is leading to a related increase in the proportion of older workers in construction (Walker and Taylor, 1999; Schaefer, 1998; Arndt *et al*., 1996). This will no doubt impact on South Africa and therefore needs to be effectively managed (Haupt, Deacon and Smallwood, 2005; Skweyiya, 2002). The older worker cohort also carries an important skill and knowledge base, which needs to be protected. This should be the primary reason for minimising injuries to older workers. Previous research on the subject of older construction workers concentrates on the impact of health related stressors on older workers with limited research on injuries specific to the older cohort. With the exception of some ongoing research by Leaviss, *et al*. (2008), not much is known comparatively about older workers versus younger workers with respect to occupational injuries and related costs - much investigation is still needed.

2.3 Construction related injuries

Injuries can be categorised into first aid injuries; medical injuries (no lost work shifts); disabling injuries (where at least one shift is lost) which can either be permanent or temporary in nature; and fatal injuries (Compensation for Occupational Injuries and Diseases Act, 130 of 1993).

The construction industry causes a disproportionately high number of injuries (Hinze, 2006). The construction industry employs about 7% of the total industrial workforce in the USA as reported by Dong, Men and Haile in a CPWR report (2005), but accounts for about 21% of all industrial fatalities. Hinze (2006) supports this finding.

Research also concludes that construction workers experience the highest rates of lost workdays (Grubb and Swanson, 1999). Further, the construction industry is responsible for the most fatalities worldwide (Pollack and Chowdhury, 2001; Suraji, *et al.*, 2001; Ngai and Tang, 1999; Coble and Haupt, 1999). Figure 1 depicts the high rates of work related fatalities in the U.S.A. in 2002.

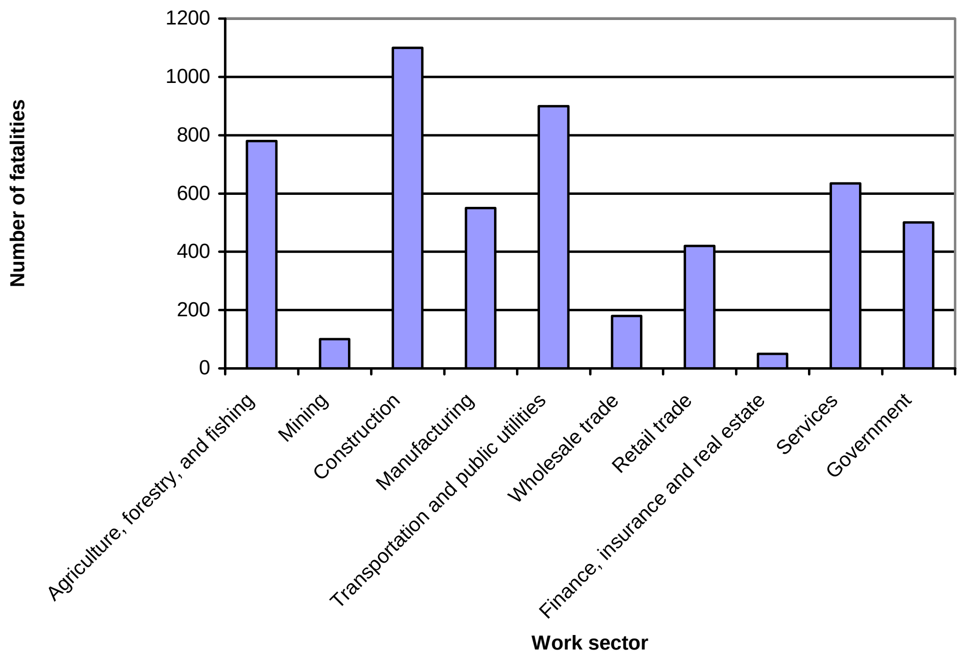


Figure 1. Distribution of worker deaths in the U.S. in 2002
(Source: Bureau of Labour Statistics)

(Adapted from Hinze, 2006:6)

The construction industry has shown a reduction in injuries and fatalities of more than 50% since the 1960's proving that improved safety and health management systems and procedures can make a difference and that the inherent unsafe nature of the industry can in fact be managed. There was an average of 220,000 disabling injuries each year in the United States alone between 1977 and 1988 (Khalid, 1996). Bentil (1992) found that out of the 15,000 fatal injuries studied by him in the United States industrial environment, 2,500 were construction related. Khalid (1996) found that in Malaysia between 1981 and 1991, 32,000 days per year were lost due to construction related injuries. This amounts to substantial costs to the industry. It was estimated that the construction industry in the U.S. lost approximately $24 million per day as a result of construction injuries. This equated to $8.8 billion annually (Khalid, 1996). With the huge annual increases in medical costs, this figure would have increased exponentially each year. More recently, as reported by the CPWR (Centre to Protect Worker Rights), between 1992 and 2003 construction fatal injuries increased by 22%. It must however be emphasised that industry employment grew by 44% (Dong, Men and Haile, 2005). Arndt, *et al*. (2005) reported that in Germany the annual injury rate incorporating both non-fatal and fatal injuries amounted to 82 injuries for every 1,000 construction workers, 2.5 times the average for all other sectors of industry. Hinze (2006) quoted the BLS, 2002 statistics where it was reported that 7.1 non-fatal injuries occurred for every 100 construction workers with 2.8 of those injuries resulting in days off work.

Specifically among the older worker cohort, Arndt, *et al*. (2005) found that disability due to construction accidents was higher for older workers and was directly related to age and period of employment. Persons employed for longer were exposed to risk for a longer period – the typical ‘dose-response’ effect. Older workers seem to be at higher risk of being more seriously injured with the resultant injury costs such as medical costs and time off work being higher (Arndt, *et al*., 2005). It is also widely recognised that age is directly related to injury recovery time, namely that older people take longer to heal from injury and disease. It suffices to say that older workers stay off work for longer as a result of work related injuries.

An injury is a result of an accident. It occurs at a fixed time and place and shows an immediate bodily impairment (Haupt, 2001). Physical injuries and indeed fatal injuries receive the most attention from employers because of the direct costs associated with them. Not all accidents result in injury or damage to equipment or material. It is in fact the near misses, those accidents that don’t result in injury or damage that hold valuable answers to what the future holds (Hinze, 2006). An accident is an unplanned and undesirable event that interrupts a planned activity. It may or may not lead to injury or property damage (Haupt, 2001). Although a distinction between accident and incident is often not clearly made, for the purposes of this study, an incident is an accident where no physical injury results.

When injuries are discussed, the terms hazard and risk invariably come to the fore. It is important to understand the difference between the two terms. A hazard is anything that may cause harm (such as, for example, chemicals, electricity, and work from ladders) while risk is the probability or chance, high or low, that somebody will be harmed by the hazard (Construction Regulations, 2003). The higher the risk posed by a particular hazard or hazardous activity, the greater the probability, chance that an injury will result (HSE, 1998). When calculating health & safety risk, the severity of the potential injury is also an important factor, i.e. the more severe the potential result of an injury, the higher the risk rating will be (HSE, 1998). Hinze (1997) believes that the answer to effective accident prevention lies in recognising near misses as potential injury indicators and taking the necessary steps to minimise the associated risk, with the aim of preventing them from occurring again. Preventing accidents on construction sites like in any other occupational environment requires firstly the provision and maintenance of a safe and healthy workplace and secondly the promotion of safe worker behaviour (Al-Mufti, 1999).

So why is it necessary to reduce occupational injuries? There are generally five main reasons why accident prevention in construction is important:

1. The cost in human suffering -

   There is a definite impact on the life of the injured person, whether it be physical pain, disability or death as well as on the lives of the family of the injured, disabled of deceased person should this be the case.

2. Moral reasons -

   This is a developed awareness by the employer into the need for improved health & safety at work - also termed 'good corporate governance'.

3. Worker morale -

   Accidents and injuries weaken worker morale.

4. Legal reasons -

   Legislation and other legal documentation demand that human life be preserved.

5. Financial -

   Accidents result in unplanned costs and are therefore difficult to budget for. Various types of insurance i.e. public liability insurance; workman's compensation cover; and contractors all risk insurance are tools used by contractors. Claims against these insurance policies lead to increased premiums and penalties, which in turn increase the cost to the employer (Holt, 2001).

Injury statistics can be useful in comparing injury rates from year to year, from company to company, or even from country to country. However, more often than not statistics are inaccurate and are not based on the same criteria (Holt, 2001). Recent studies by the Health & Safety Executive in the UK found that only 55% (1997/98) of all non-reportable injuries in construction were actually reported to the HSE and local authorities. This was however an improvement on previous years (Holt, 2001). Non-fatal and less serious injury statistics can therefore only be used as an indicator when determining injury trends. Fatal injuries, however, which are more difficult to ignore seem to be better reported and lead to improved statistical records (Holt, 2001).

2.4 Accident causation

Accidents and injuries do not just happen - they are caused by varying, factors. The accident causation process is a complex one (Suraji, Duff and Peckitt, 2001). Can all accidents be prevented? The most morally acceptable answer would be, "YES'' as put forward by the premise of 'zero injury construction projects' (Hinze, 2006). The Occupational Health & Safety Act no. 85 of 1993 (South Africa), places the duty on the employer of a worker to: "provide and maintain a working environment that is safe and without risk to the health of his employees" (OHS Act, 1993:3). From the wording of this employer duty (Section 8 of the OHS Act, 1993), it would seem as if the legislators hold the view that all risks can be eliminated. A proviso has however been included here – "as far as reasonably practicable". This adds a different slant to the premise that all risks and therefore all accidents can be prevented. The legislators seem to understand that due to the complex nature of accident causation, not all accidents can be prevented by management alone. This does however still not answer the question. Can all accidents be prevented? Perhaps the most logical way to arrive at the answer is to start by investigating the accident causation theories.

Several accident causation theories have been developed to explain the causes of accidents. Arguably, policy makers when adopting accident management systems should be familiar with these theories.

The two primary categories of accident causes are unsafe acts or behaviours and unsafe conditions or situations (Kartam and Nabil, 1997). When it comes to both unsafe conditions and unsafe acts, two elements exist, namely the technical causes leading to the failure and the procedural errors, which allow the faults to occur (Jones, 1996). Two studies conducted in the United States arrived at the following results (Haupt, 2001; Rowlinson in Coble *et al*., 2000):

National Safety Council

- 88% of accidents were due to unsafe behaviours
- 10% were due to unsafe conditions

- 2% due to unclassified causes

Du Pont company study

- 96% of accidents were due to unsafe behaviours
- 4% were due to unsafe conditions

From these statistics it is clear that unsafe worker behaviours are by far the most direct cause of accidents and injuries. But what leads to these unsafe acts and conditions – what are the underlying causes that trigger unsafe worker behaviour? The accident causation theories attempt to answer this question.

2.4.1 Axioms of industrial safety

One of the first theories formulated was by Heinrich and aptly named Heinrich's "axioms of industrial safety" (Heinrich *et al*., 1980 in Rowlinson 2000).
Heinrich's axioms (summarised) as listed in Rowlinson (2000):

1. Injuries result from a sequence of factors, the last of which is the accident itself.
2. Unsafe acts of persons cause the majority of accidents.
3. Three hundred narrow escapes from serious accidents will have occurred before a person suffers injury caused by an unsafe act.
4. The severity of an accident is largely a matter of chance.
5. Accident prevention methods are similar to those methods used for cost control, quality control, and production management. Management is in the best position to initiate accident prevention strategies.
6. The art of supervision is the most important influence on successful accident prevention.
7. The humanist view of accident prevention can be usefully enhanced by a consideration of economic forces.

Building on these axioms, Bird (1974) produced the domino sequence model, which compared the result of an accident to a line of dominos. If the one falls, the others are also knocked down. Bird (1974) also argued that construction managers had the most control over accidents and were therefore the critical role player in accident prevention. Bird (1974) believed that the first domino in the sequence was management and if it fell, the sequence of failure was triggered.

Adams (1976) then further elaborated on the domino effect in the following way:

Domino 1 – management structures i.e. organisational objectives; chain of command; who makes what decisions; work procedures and provision of equipment.
Domino 2 – operational areas i.e. management behaviour and supervisor behaviour. Management needs to set policies – when these fail it is due to unclear goals, failure to take control and make decisions and overlapping of areas of authority. Supervisor shortcomings on the other hand are identified as failure to set a good example, not taking responsibility, not giving clear instructions and failing to enforce discipline.
Domino 3 – Tactical errors such as unsafe acts and conditions.
Domino 4 – Tactical errors resulting in an accident.
Domino 5 – Tactical errors resulting in damage or injury.

Petersen (1988) challenged the domino theories and questioned the probability that the cause of an accident could be multiple in nature. In other words many causes may converge resulting in an accident outcome.

Further theories to explain accident causation are discussed below.

2.4.2 The Accident-Proneness theory

It is believed that some individuals will be more likely to be injured than others. They are ‘accident-prone’. This could be due to personal factors and explains that injuries do not just happen by chance. Vernon (1918 in Rowlinson 2000) stated that certain personality traits made certain workers more vulnerable than others. These traits include aggressive tendencies, social maladjustment and outgoingness among others. Studies on groups of workers have shown that certain workers sustain more injuries than others and that chance alone is not a factor (Farmer and Chambers 1929 in Rowlinson 2000).

This theory is however under scrutiny and is often not the preferred accident causation theory. Factors like influence by fellow workers and personal problems were never investigated and add to the invalidity of the theory. It is also believed that accident proneness may change with time, that is, one will take less risks when you have a family compared with when you were young and carried less responsibility. From this accepted pattern, it can be deduced that risk taking reduces with age (Hinze, 2006). Although accident-prone workers are seen as being ‘high risk’, it was found that workers who attended health and safety training sessions had fewer accidents (Denning, 1983).

The accident proneness theory does not carry enough evidence and requires more research into exactly what actions lead to accidents, the variances in hazards and whether the accident was due to a fellow worker. The answers to these factors may validate or disprove the theory altogether (Hinze, 2006).

2.4.3 The Goals-Freedom-Alertness theory

This accident causation theory suggests that a psychologically rewarding work environment leads to safe work performance (Hinze, 2006). The theory explains that an environment that does not stimulate a sense of alertness leads to complacency and low-quality work behaviour. Kerr, who first suggested the goals-freedom-alertness theory in 1950, alluded to the fact that a worker who knows how to do a job and understands the goals will be well focused on the job at hand and will be less likely to be injured. Workers should always be involved in problem solving if they are to remain alert and positive.

Unfortunately few studies have tried to test this theory and there is little support due to this. Kerr (1950) found that workers in one department of a particular firm sustained more injuries than the other departments. This ‘high risk’ department happened to have the lowest promotion opportunity and inter-company transfer rates. One could argue however that the more hazardous tasks were being performed in this department.

The theory states that companies should train their managers and foremen to make the work more rewarding for their workers. Managerial techniques like participative management, clear task layout, positive encouragement, and goal setting may assist the workforce in acting safer and having less accidents.

2.4.4 The Adjustment-Stress theory

The adjustment-stress theory states that a work environment that diverts the attention of workers negatively impacts safe work performance. This was Kerr’s second theory and followed on the back of his goals-freedom-alertness theory. Certain unexplained variances left by his first theory would be investigated and explained by the adjustment-stress theory. This theory suggests that “unusual, negative, distracting stress” placed on workers increases their “liability to accident or other low quality behaviour” (Kerr, 1957). The theory postulates that accident occurrence increases as a result of negative internal environment stresses like fatigue, alcohol consumption, loss of sleep, drugs, disease, worry, personal problems or anxiety. Apart from the internal environment, the external environment also plays a part. Factors like noise, illumination, temperature and excessive physical strain may lead to an increase in the chance of injury. Workers whose attention is diverted during work time will be more susceptible to injury (Hinze, 2006). For construction workers, the external diversions are very apparent, add to this some internal diversions and the recipe for an accident may be written. Direct on-the-job stress caused by unrealistic, unattainable goals set by managers and even by the construction client like tight deadlines and cost constraints also increase the risk of injury. The accident-proneness theory is slightly different in that it states that certain workers are inherently more at risk while the adjustment-stress theory speaks of temporary conditions that affect a worker.

2.4.5 The Distractions theory

Hazards present in the work environment complicate the process of completing a task successfully. Hinze (2006) observed that workers would be more successful in achieving their task goals if distractions from known hazards were less. In other words when workers have to concentrate on existing hazards, they cannot focus on the job at hand, leading to low task achievement. It can therefore be deduced that should productivity be increased, hazards must be eliminated so that less attention isplaced on them by the workers.

If a hazard exists, the worker potentially at risk should place the necessary attention on avoiding the hazard, this diverts the worker's attention from the real task activities. Quality and productivity are therefore negatively affected. Workers who do not place adequate attention on the hazards may potentially be at higher risk to injury. Thus eliminating hazards should be the primary concern of managers and foremen if they are to achieve better quality products, improved productivity and reduced rates of injury.

Hazards are defined as physical conditions with inherent qualities that can cause harm to a person (Hinze, 2006). However it may be possible that a person is considered the source of the hazard as he/she is not in the proper state of mind and therefore places themselves at risk. An improper state of mind may be caused by mental distractions such as financial concerns, family disputes, competition at work, and drug or alcohol abuse among others. Even positive distractions like celebrations and parties may pose a threat to the safety of a worker. Evidence has been provided which indicates that mental state of mind plays a prominent role in causing disease

(Holmes and Rahe, 1967). These stressful events may be negative or positive in nature and can be classified by means of a points system. By adding up the points, one can assess an individual's risk level.

The distractions theory consists of two main components namely unsafe physical situations and workers' distractions by sideline issues – these two when put together are purported to have an accident outcome.

2.4.6 The Chain-of-Events theory

As discussed previously when investigating Heinrich's axioms, injury accidents can be due to a sequence of events, one event following on the next, with the final event resulting in an accident or injury. The chain-of-events theory indicates that all the events need to run concurrently for the accident to occur. Should one of the steps be eliminated, there is a good chance that the potential injury will be averted or prevented.

When injury investigations are conducted, the focus is all too often placed on the injured worker. The conclusion is usually that the worker was at fault. This perceived 'worker negligence' was however merely the final event in the chain. The steps leading up to the 'worker negligence' were out of his control and could be attributed to factors such as poor working conditions, inadequate management systems and company policies, time constraints, etc. Very often in the chain of events leading to an injury lies a management related failure or oversight leading one to believe that construction managers, top, middle as well as team leaders all have a role in changing the course of a potential accident causing situation.

Fine (1975 in Hinze 2006), concluded after conducting an extensive study of management's role in accidents that "all accidents and hazards are indicators of management failures".

Management failures can be anything from failure to enforce procedures, failure to train workers, failure to supply competent supervision to incorrect placement of workers and failure to motivate workers and incentives positive health & safety behaviour.

Following on management shortcomings, and understanding that they have an important role to play, construction managers and foremen must believe that their actions can directly prevent injury accidents. Among other things they need to provide the necessary skills training and health & safety training including training in risk minimisation and elimination strategies. They need to introduce programmes like incentives for positive health & safety performance by workers.

When looking at injury causation one must also consider the various role players and understand how they are involved in the construction process. Each of them from the owner to the architect, from the site manager right down to the worker carrying out the task plays a role in causing injury accidents. But similarly they also each have the ability to break the chain-of-events leading to an injury. A typical hierarchical structure on a construction site is shown in Figure 2: Owner/developer – project manager/principal agent – professional engineers – architect – principal contractor – contractors – sub-contractors – workers.

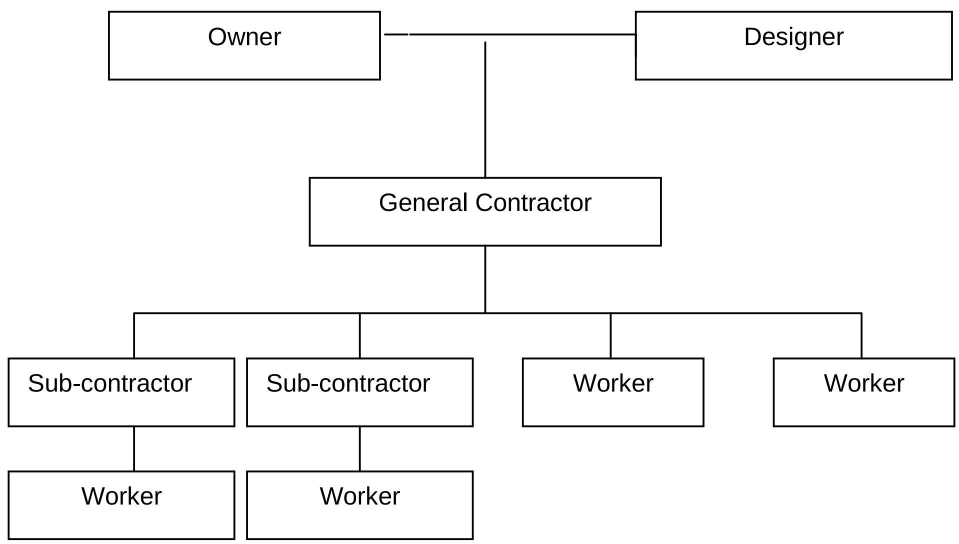


Figure 2. Organisational chart on a typical construction project

(Adapted from Hinze, 2006:31)

What must be learnt from the various accident causation theories is that accidents are not superficial in nature, merely caused by unsafe acts and/or conditions, but are complex multi-causal situations with their roots often embedded in management policies and approaches. Injury prevention solutions should therefore be found not in the most direct causes of an injury, but in the underlying causes such as a lack of training; ineffective supervision; and communication failures.

2.4.7 Reason's framework for accident causation

Reason's framework, otherwise called "the Tripod model" concentrates on the underlying mechanisms involved in accident causation rather than just looking at the accident scene. Reason called these mechanisms general failure types (Suraji, *et al*., 2001). These general failures included bad design, unsafe hardware, inadequate procedures, conditions with a high chance of error, poor housekeeping, lack of training, incompatible objectives, unclear communication, bad organization, unscheduled maintenance management, and inadequate defence mechanisms (Suraji, *et al*., 2001). Reason (1990) proposed that accidents, unsafe acts and latent failures were interrelated and that the latent failures in technical systems combined with triggers in the working environment such as human violations and technical faults otherwise termed active failures may lead to the resultant accident. The latent failures actually arise as a result of upstream precursors like bad management decisions, manager incompetence and psychological precursors. These psychological precursors were further defined as being factors like high workload, unfair time frames for carrying out tasks, or inadequate and even non-identification of hazardous situations. It is apparent when studying this model that human failures, whether upstream or downstream are a central cause of accidents.

2.4.8 The Constraint-Response theory

This theory or model is based on the notion that each participant in the lead up to an accident experiences constraints on their activity. The responses to these constraints in turn lead to further constraints to subsequent participants in the process. These constraints and associated responses eventually manifest themselves downstream in what Suraji, *et al*. (2001) terms the proximal factors or failures.

Instead of latent and active failures as put forward by Reason, the constraint-response theory talks of distal and proximal failures as depicted in Figure 3. The distal failure, such as the failure to conduct an asbestos survey of a building before demolition, ultimately leads to the proximal failure, in this case demolishing a building comprising asbestos containing products. The proximal failure leads directly to the risk exposure or accident involving the worker.

Although this theory is based on Reason's framework for accident causation, it includes a practical facet, which allows it to be adapted for effective injury investigation and intervention on construction projects. Suraji, *et al*. (2001: 337), believed that "the effective mitigation of causal factors requires better knowledge of what factors are most influential, who may reasonably be expected to control those factors and how such control may most effectively be achieved"

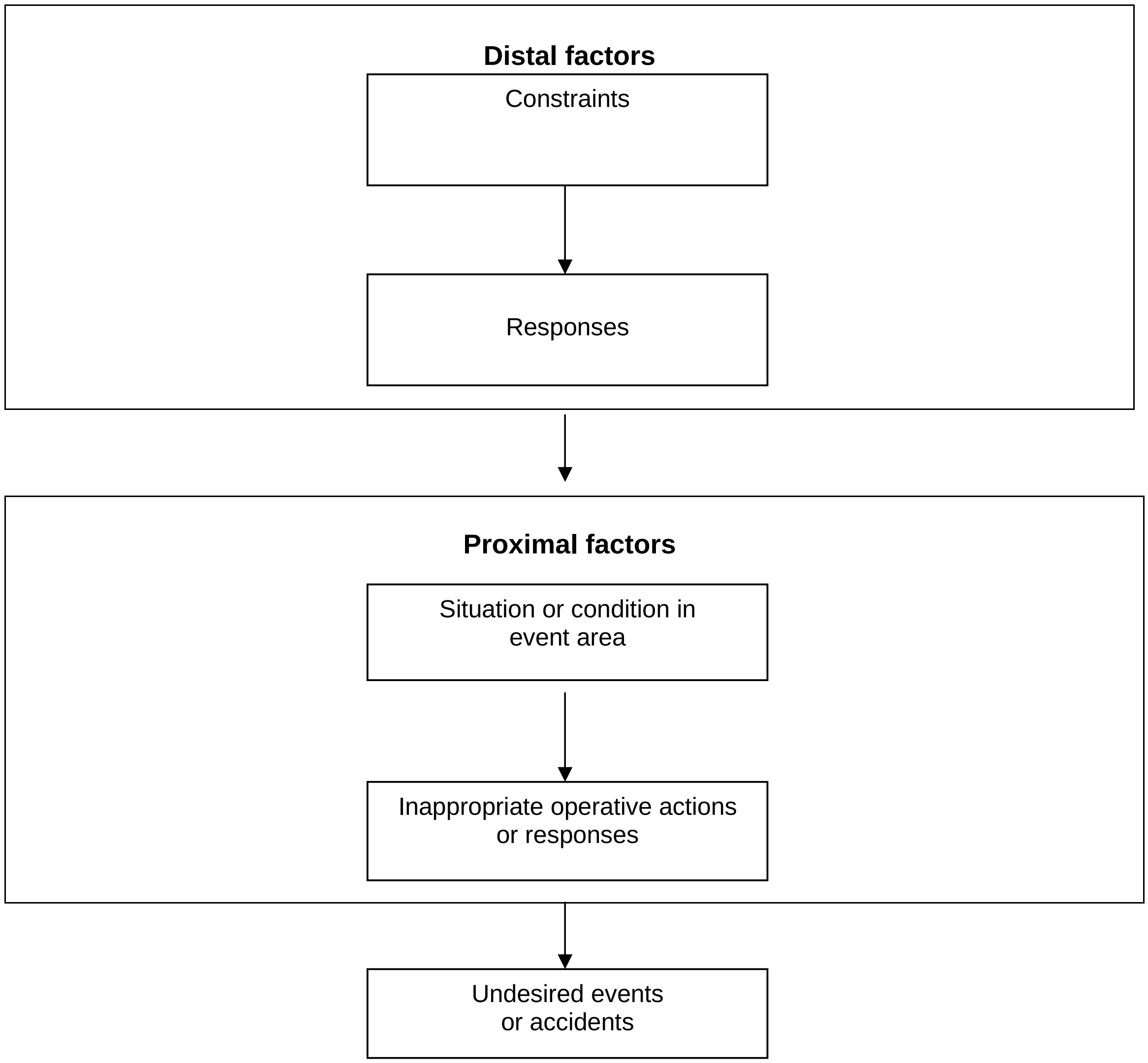


Figure 3. Summary of the Constraint-Response model for accident causation

(Adapted from Suraji *et al.*, 2001:337)

2.4.9 Further Accident Causation models

Some other recent accident causation models include Nishishima's fishbone model where he proposes that four related factors lead to unsafe acts or conditions namely human, equipment, work, and management factors (Suraji, *et al*., 2001).

Bellamy *et al*. (1992) identified five causal factors, which made up their socio-technical pyramid model. The factors were: engineering reliability, operator reliability, communication and feedback control, organization and management, and finally psychological climate.

Whittington, et al. (1992 in Suraji, *et al*., 2001) simplified the processes leading to accidents by proposing that a sequence of failures initiated an accident starting upstream with policy failures, project management failures, site management failures, and ending with individual failures.

In support of certain accident causation models, Haupt and Seevaparsaid-Mansingh (2008) noted that safety violations are known to occur more frequently in situations where responsibilities are ambiguous or ill-defined, training poor and time pressures high – not atypical conditions for the construction industry.

2.5 Events Leading Directly to Construction Injuries

Given that the various accepted accident causation theories have been put into perspective, the events leading to injuries (falls, overexertion, struck by), the nature of the injuries (fractures, burns, lacerations), and body parts affected (hand, finger, head) need to be examined in more detail. This information is important so that resources can be directed to the areas leading to the most injuries, the most serious injuries and the injuries costing the most. Comparisons between the younger and older age group injuries will also be made by investigating the related literature.

Work related injuries can be categorised according to the events or exposures that lead to the injuries. OSHA, the Occupational Safety & Health Administration (USA) uses the following categories: falls from elevation; struck by; caught in/between; electrical shock; other. The U.S. Bureau of Labour Statistics (BLS) makes use of slightly different categories: falls; transportation; contact with objects and equipment; exposure to harmful substances or environments; assaults and violent acts; and fires and explosions. In South Africa, the Department of Labour's workman's compensation division and the Federated Employer's Mutual Assurance Company, (FEMA) a registered private construction assurance provider places injury events into the following categories: struck by; striking against; fall onto different level; fall onto same level; caught in/on/between; slip or overexertion; contact with electrical current; contact with temperature extremes; and injury type not otherwise classified.

By studying the various data bases and literature on events leading to accidents and injuries it becomes possible to identify the causes of injuries and more importantly what events lead to most injuries on construction sites. The literature also indicates that minor injuries, serious injuries and fatalities don't necessarily show the same distribution and category percentages (Hinze, 2006). In other words the trends of causes leading to minor injuries (injuries not resulting in lost time) are often quite different from those resulting in serious injuries or fatalities.

Sweeney (2000) found that for non-fatal injuries to workers in the United States construction industry, overexertion was the most common cause/event and that sprains/strains was the most common diagnosis. This was in contrast to fatal injuries where falls from elevated areas was seen to be the event leading to the most deaths.

The literature, although not widespread made reference to injury events and age distribution/frequency. Some examples were:

- Falls from elevations – The average age of fatally injured workers in this category was 40.3 years with the highest rates being for workers between 20-24 years. More than half of the victims were 39 years of age or less (Sweeney, *et al*., 2000).
- Electrocution – The median age of death was 26.5 years with most fatalities occurring between the ages of 20 and 24 years and declining to retirement age (Sweeney, *et al*., 2000).
- Machine related – The mean age of construction workers killed in machinery incidents was 40.5 years, with more than 25% of the victims being between 25 and 34 years old (Sweeney, *et al*., 2000).

Table 1. Events leading to injuries in the Chinese construction industry (1999)

Accident category	Fatality	Severe Injury
Falling from height	524 (48)	133 (44)
Electrocution	124 (11)	4 (1)
Hit by falling materials	116 (11)	45 (15)
Collapse of earthwork	148 (13)	36 (12)
Use of heavy machine	71 (6)	38 (13)
Lifting of weights	45 (4)	18 (6)
Toxic and suffocation	29 (3)	2 (1)
Use of motor	8 (1)	3 (1)
Fire and explosions	20 (2)	3 (1)
Others	12 (1)	17 (6)
Total	1097(100)	299 (100)

The figure in parentheses indicates the percentage of the total.
Source: China Statistical Yearbook of Construction (2001), pp. 105.

Table 2. Statistics of injuries according to how they occur (Turkish construction industry)

Type of injury	Fatalities	% of total
People falling	538	36.6
Material falling	139	9.5
Caving of excavations	98	6.7
Part of structure collapsing	86	5.9
Shocking by electricity	212	14.4
Injuries by construction machines	162	11.0

Source: Adapted from a paper by Mungen, 1997. Employment related accidents in the Turkish construction sector and applications of occupational safety. Health and Safety in Construction, 1997, Eds. Haupt and Rwelamila.

Table 3. Fatal work related injuries in the U.S construction industry from 1992 through 1996, based on the CFOIs (Census of Fatal Occupational Injuries) – Event or exposure leading to death

Year	Transport-ation (%)	Assault or violent act (%)	Contact with object or equip (%)	Falls (%)	Exposure to harmful substances (%)	Fire (%)
1992	24.5	3.0	19.7	29.2	8.8	3.0
1993	25.2	4.0	20.2	29.5	17.2	3.5
1994	25.8	2.7	17.8	32.1	19.6	3.3
1995	25.1	3.1	18.2	32.0	16.3	2.0
1996	25.3	2.1	20.8	32.4	8.0	2.8

Source: Bureau of Labour Statistics

Table 4. Frequency of occurrence of different causes of fatalities (%)

Event type	1985-1989	2002-2003
Falls	33%	35.9%
Struck by	22%	21.5%
Caught between	18%	16.5%
Electrical shock	17%	13.9%
Other	10%	12.2%

Source: Hinze, 2006. Construction Safety, pp. 108

Table 5. FEM claim statistics (fatalities) – Western Cape region

Description	Fatals (Jan–Jul'06)	Fatals (Jan-Jul'07)
Falls onto different levels	8	2
Struck by	2	2
Caught in, on, between	2	1
Fall on same level	0	0
Other	1	0

Source: FEM statistical records 2006 and 2007

Table 6. FEM claim statistics (fatalities) – South Africa

Description	Fatals (Jan–Jul'06)	Fatals (Jan-Jul'07)
Fall onto different levels	13	7
Struck by	11	5
Caught in, on, between	3	3
Fall on same level	0	1
Other	3	3

Source: FEM statistical records 2006 and 2007

McCann and Chowdhury (2000) found that falls from ladders (a leading cause of serious injuries) composed 60% of all fall related injuries occurring to workers aged 44 years and over. This finding suggests that balance and body weight may have been causative factors leading to the high percentage of falls from ladders among that age group.

Some research suggests that serious occupational injuries involving death or disability increase with age while less serious injuries decrease (Zwerling and

Sprince, 1996; Stalnaker, 1998). In contrast to the above premise, other research shows that age alone does not differentiate between workers, and therefore dismisses claims that older workers are more accident prone (Patrickson and Hartmann, 1995). Dilley and Kleiner (1996) found that the highest rate of injury was sustained by male workers under the age of 25 years with a “steady decline” in the following years. Further research points to younger worker accident rates being comparatively higher due to their relative inexperience of the tasks to be performed. Older workers’ accidents could be a consequence of the higher risk activities which have to be performed by them (Patrickson and Hartmann, 1995). In Australia, the Work Cover Authority of New South Wales (1994) found that the highest accident percentage fell within the male age group of 25-29 years (13.1 %). For females, the highest accident percentage age group was 40-44 years (14.8%). An interesting finding was that time off work rose with age for each age cohort (Work Cover Authority of NSW, 1994). Brooke (2003) didn’t so much find that older workers were more prone to injuries, but did come to the conclusion that claims cost more with an increase in age. Hinze (2006:251) best summarises the argument regarding age and associated injury rates: “Although statistics may suggest that injury occurrence is associated with age or other demographic variables, such associations tend to be inconclusive.”

2.6 The nature or type of construction injuries

Injuries are grouped into categories for reasons of reporting and statistical analysis. The type of injury is based on the physical nature of the injury and is categorised into groups such as: burns; lacerations; fractures; foreign body in eye; sprains/strains; amputation; and multiple injury.

Varying reporting groups and categories were used by the different organisations in the literature, which did not make for universal statistical analysis.

The Federated Employer’s Mutual Assurance Company (FEM), a registered workman’s compensation insurer for the construction industry in South Africa makes use of 25 categories or codes when reporting on ‘nature’ of injury claims. The categories applicable to construction related injuries will be used when analysing ‘older worker’ injury data later in the study.

The nature or types of injuries identified in construction are directly related to the working environment, both the natural and man-made environments such as foreign body entering the eye of a worker could be due to a the wind blowing a particle of sand into the worker's eye (environmental) or due to a piece of steel during a grinding or cutting operation (man-made). Hard physical labour, static work, climatic influences, noise, and dust typically characterises activities on construction sites (Haupt, Deacon and Smallwood, 2005). Construction workers in general seem to complain about awkward postures, vibration and climate (Haupt, Deacon and Smallwood, 2005). Musculoskeletal disorders like sprains and strains to the back, knees and wrists are a major type of construction related injury and make for costly compensation claims (Schneider, 1997).

An interesting finding was that of the rate of finger amputations in construction being higher than in all other industries according to Olsen and Gerberich (1986).

Eye injuries are often reported as being most prevalent in the construction industry compared with other industries (BLS, 1998) and can take various forms such as foreign body scratches to the cornea; foreign bodies being embedded in the eyeball; chemical splashes to the eye; radiation burns due to welding. The National Institute of Safety and Health (NIOSH) estimates that 40,000 U.S. construction workers were treated in emergency rooms for work related eye injuries in 1996 (Jackson *et al*., 1998 in Rowlinson, 2000). Eye injuries were also reported to be more prevalent amongst younger workers (Hinze, 2006).

Lacerations were also more prevalent in younger workers probably due to their relative inexperience and exposure to menial tasks involving tools and equipment. Hinze (2005) suggested that older workers were often in 'lead positions' so their exposure to injury was less than for their younger counterparts. Lacerations and eye injuries were seen as being less costly than other injuries and did not result in many lost work days however their frequency was high meaning that they should not be overlooked when it comes to company injury prevention strategies.

Fractures were more prevalent in the older construction worker cohort and were probably due to older workers having more brittle bones and slower reaction times (Hinze, 2006).

2.7 Bodily location of construction injuries

Reporting on what part of the body was affected by an accident, like nature of the injury and type of injury, gives valuable information on what the result of the injury was.

As with the nature of injury, the categories for body part injured varied somewhat depending on the literature source and reporting agency. Some were more detailed than others with more reporting categories used in some instances. Once again there was no common reporting standard.

The Federated Employer's Mutual Assurance Company (FEM) makes use of fifty-three categories when reporting on 'bodily location' involved in injury claims. Certain of these categories will be used when analysing 'older worker' injury data later in the study.

Hinze (2006) found that there were differences in injury by bodily location and age. He purported that older workers were more prone to injuries affecting the knees, upper extremities, and lumber spine. The lumber spine injuries were also the most costly, making up 20% of the total medical costs for construction patients. Shoulder injuries were also higher in older workers and proved to be costly. This is more than likely due to the high potential for surgery linked with the resultant physiotherapy required. Time off work for these musculoskeletal injuries was seen as high meaning more work disruption and higher compensation claim costs. Older workers were often employed in construction for longer periods than younger workers and were therefore often exposed to hard physical labour such as picking up heavy objects, bending continuously, and carrying out monotonous tasks year after year thus resulting in a higher chance of certain associated injuries.

2.8 The agencies involved in construction injuries

An understanding of the physical operations, tasks and/or physical components involved in construction injuries is similarly important so that areas of higher risk can be identified and controlled.

Hinze (2006) cited a Bureau of Labour Statistics analysis of OSHA construction site violation results. The violations were categorised as follows: Scaffolding; hazard communication; fall protection; lock-out/tag-out; respiratory protection; electrical; machine guarding; mechanical plant, to name a few. The aim of the study was to determine which OSHA standards were most often contravened.

Rowlinson (2000) describes the agents most commonly involved in injuries as follows: Stored materials; materials lifted; fixed structure; dust/sand/chippings; power hand tools; non-power hand tools. It's also worth noting that injury agents can also be linked to types of injuries i.e. injuries caused by non-powered hand tool resulted in hand injuries (62% of the time). Stored materials resulted in injuries mainly to the legs (29%), the feet (26%), and the trunk (21%). This seems to suggest that stacking/storage and associated housekeeping was a problem.

The Federated Employer's Mutual Assurance Company (FEM) makes use of 34 categories when reporting on 'agency' involved in injury claims. This research study will however not investigate the agencies involved in construction injuries.

As far as older worker injury agents go, a typical example identified in the literature was stepladders. As mentioned earlier, McCann and Chowdhury (2000) found that falls from ladders (a leading cause of serious injury) composed 60% of all fall related injuries occurring to workers aged 44 years and over. This seems to suggest that older workers either work on ladders more often or that they have a predisposition to working on ladders.

In the study by Rowlinson (2000), manual handling related injuries as an example of an injury agent made up 16% of the sample. There was however no conclusive evidence that older or younger workers were more predisposed to injury by this agent. In fact Stubbs and Nicholson (1979) found that back injuries were more common in younger workers while analysis of the Housing Authority of Hong Kong statistics by Rowlinson (2000) found the converse.

According to Patrickson and Hartmann (1995), ageing was associated with an increased vulnerability to problems such as poor eyesight, poor hearing and the increased risk of falling, which seems to backup the findings of McCann and Chowdhury (2000) in their study on older workers and falls from ladders.

2.9 Injured workers and their job descriptions

The literature relating to construction accidents was seen to be quite universal when categorising construction trades or job descriptions. The trades seemed to be similar for most countries with minor name differences.

The general classification 'unskilled workers' are at higher risk of injury compared with their counterparts, the 'skilled workers', due to exposure to more physically demanding jobs as well as being 'in the frontline' when it comes to exposure to risk (Guberan and Usel, 1998). Plasterers, carpenters, general workers (labourers) and bricklayers were seen to be at higher risk of injury leading to disability as an outcome (Arndt, *et al*., 2005).

2.10 The Cost of Construction Injuries

Considering that the average cost of injuries in 1998 as reported by the Workman's Compensation Fund for workers injuries (all industries) was R4,362 having increased from R2,558 in 1993. And more recently in 2002 as reported by the construction industry's registered insurance provider FEM, the cost of injuries was R3,950 on average, increasing to R10,225 in 2006. Minimising the cost of construction injuries should be high on an organisation's list of priorities.

In the 1970's the Confederation of British Industry (CBI) stated: 'At the company level, if a readily applied and simple formula could be devised by which the financial loss caused by accidents and diseases could be measured …, it would make a valuable contribution towards reducing industrial accidents and occupational ill health' (The Health & Safety Executive, 1993 in Al-Mufti, 1999)

Implementing and successfully running a health & safety management programme within a company costs money. The Business Roundtable – USA (1991) substantiated this statement back in 1980 after collecting data from a large sample of construction companies. They concluded that the cost of administering a construction health & safety programme amounted to approximately 2.5% of a company's direct labour costs. Smallwood (1992) then determined the actual cost of health & safety to be 0.22% of the total project cost after conducting extensive research on construction projects in South Africa. According to Hinze (2006), the cost of health & safety ranges from below 1% all the way to over 10% of project cost which seems to be due to a varied basket of items being included in the budget when costing safety and health for a project. Items often included as part of health & safety costs are: safety related training; personal protective equipment; fall prevention barriers; safety related notices and signs; project safety personnel; workman's compensation; and could even include scaffolding.

According to Rowlinson (2000), an 18 week study carried out by the HSE (Health & Safety Executive) in the UK calculated that the total cost of accidents on the project concerned amounted to 8.5% of the initial tender price. This happened to be more than the profit margin expected by the contractor. Further to the percentage accident cost compared with project value, being able to objectively and systematically calculate individual accident costs can also prove to be valuable propaganda. Kartam (1997) quoted the figure of $18 000 as being the average cost of construction injuries for the period of his research. The Federated Employer's Mutual Assurance Company (RSA) paid out over R100 million (approximately $12.5 million) in 2006 for construction related injuries. This amounted to over R10 000 per claim (9,172 claims). The Department of Labour in South Africa paid out R319 million (approximately $40 million) for general industry related injuries during the last financial year (Haupt and Pillay, 2008). Insurance payouts are limited to medical costs, compensation of employees' salaries or wages (75% of employee's wage) and in the case of fatalities, payment of a pension to the deceased's family. Insurance costs are merely a portion of the total cost of injuries to industry, classified as the direct portion, which is easily quantifiable.

It is generally accepted that injury costs are divided into two principal categories namely direct and indirect (Hinze, 2006). Two further related categories also come to the fore, namely insured and uninsured costs (Al-Mufti, 1999). These categories are depicted in Figure 4.

	DIRECT	INDIRECT
INSURED	employer's liability and public liability claims; damage to buildings; damage to vehicles	business interruption; product liability
UNINSURED	sick pay; repairs; product lost / damaged	investigation costs; loss of goodwill; loss of corporate image; hiring and training of replacement staff

Figure 4. Direct and indirect costs

(Adapted from Health & Safety Executive, 1993 in Al-Mufti, 1999)

The construction industry's high-risk nature and resultant high injury rate means that company insurance like Contractor's All Risk and Workman's Compensation have increased exponentially over the years, especially in countries where employees have the right to litigate against their employers (Ma and Chan, 1999). Brooke (2003) suggests that workman's compensation costs industry more than both strikes and leave combined. Insurance premiums are based on the risk profile of a particular company and companies with a poor safety record will soon lose their competitive edge should their insurance premiums become too expensive. Some insurance companies send health and safety as well as fire risk consultants to project sites at predetermined intervals with the aim of assessing the risk profile of the project and thereby determining whether the insurance premiums should be increased. The controlling of insurance costs in itself makes financial sense and should sway company management and decision makers to invest in project health & safety. Hinze (2006) also suggests that more work is required in this area of health and safety costing so that project health and safety costs can be more accurately calculated. As with any company strategy, of which health & safety is one, the ultimate success of the strategy or programme is based on whether it will cost money or save money. Some company executives may argue that health & safety is not merely a 'money' issue but is based on moral principles and good corporate governance. It goes without saying though, that one should be able to calculate the costs of accidents and injuries with some level of accuracy so that company management realise what poor health & safety management could cost them or is presently costing them.

2.10.1 Direct injury costs

The costs included in this category are generally those covered by workman's compensation and are quite easy to quantify i.e. percentage of wages paid to workers while off work; ambulance; hospitalisation; general medical expenses; disability pay out; and could also include damage to equipment or property involved in the injury.

Previous research has shown that older workers may not necessarily be at higher risk of injury, however when they do get injured, they generally take longer to recover meaning that they tend to remain off work for longer and have to attend more visits to doctors, occupational therapists and physiotherapists (Brooke, 2003). Staying off work and doctors bills are examples of direct injury costs and seem to be higher among older workers in relation to younger workers (Patrickson and Hartmann, 1995; Work Cover Authority, 1994). Leading from the premise that older worker injuries lead to more time off work, one must keep in mind that older workers are generally in higher positions in their company and therefore tend to be on higher salary or wage scales thus increasing the cost of injury even further.

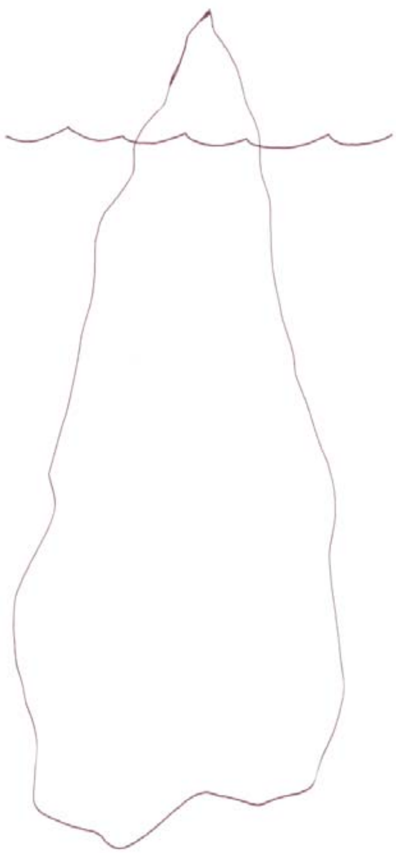
2.10.2 Indirect injury costs

Indirect injury costs are not well defined and are therefore not easily linked to the injury event. Hinze (2006:66) states "indirect costs are those for which there is no retrieval mechanism to accurately associate them with injuries." For this reason indirect costs often remain "hidden".

Heinrich (1941) categorised indirect injury costs as follows:

- Cost of lost time of injured worker;
- Cost of lost time of other workers who stop work;
- Cost of time lost by foreman, supervisors, or other executives;
- Cost of time spent on the case by first aid attendants and other staff;
- Cost due to damage to equipment, tools, property, and materials;
- Incidental cost due to interference with production;
- Cost to employer under employee welfare and benefit systems;
- Cost to employer for continuing wages of injured worker;
- Cost due to loss in profit due to reduced worker productivity;
- Cost due to loss in profit due to idle equipment;
- Cost incurred because of subsequent injuries partially caused by the incident; and
- Cost of overheads (utilities, telephones, rent, etc.)

Another way of looking at the relationship between direct and indirect accident costs is by using the analogy of an iceberg an shown in Figure 5 – only about 10% of the iceberg is visible above the water, the bulk is submerged or for the purpose of this analogy, hidden.



Insured costs:

Employer's liability and public liability claims;

Workman's compensation;

Damage to buildings;

Damage to vehicles

Uninsured costs:

Product and material damage

Plant and building damage

Tool and equipment damage

Legal costs

Expenditure on emergency supplies

Clearing and stopping the site

Production delays

Overtime working

Temporary labour

Investigation time

Supervisor's and other staff time

Fines/penalties

Loss of expertise

Figure 5. Accident costing iceberg – the hidden cost of accidents

(Adapted from Health & Safety Executive, 1993 in Al-Mufti, 1999)

Previous research on indirect injury costs have realised varying results with ratios between indirect and direct injury costs being anywhere from 0.23 to 20 (Hinze, 2006; Grossman, 1991). This proves that indirect injury costs are not universally recognised and there doesn't seem to be consensus on how they relate to direct costs. The result of which is a lack of acceptance by company managers of the true cost of accidents in their organisation.

Indirect costs of injuries can stretch far into the future and can even culminate in a substantial penalty for a negligent transgression by the employer or civil litigation by the injured employee where workman's compensation allows for an employee to litigate against an employer even after a compensation claim has been lodged – in South Africa, this is however not the case. In California, U.S.A it is believed that 1 in every 8 lost-workday cases results in a liability suit (Hinze, 2006). Head and Harcourt (1996) argue that encouraging older workers back into the workforce constitutes an indirect injury cost. Hinze (2006) purports that indirect costs should be limited to a few months after the injury as long term costs could be too difficult to quantify accurately. Figures 5 and 6 show the breakdown of indirect injury costs for both medical injury cases and lost day cases. In 1991, the Construction Industry Institute (CII) together with the University of Washington embarked on a study to quantify the true costs of construction injuries with special emphasis on the indirect, hidden costs (Hinze, 2006). The research did not attempt to quantify all indirect costs and concentrated on those costs closest to the construction site/project thus eliminating those costs, which cannot be fairly accurately calculated i.e. pain and suffering and financial and emotional affect on family to name just two. The sample of injury information was sourced from one hundred construction companies and one hundred and eighty-five sites. Injuries were divided into medical cases (where workers consulted a doctor and returned to work) and lost workday injuries (where worker consulted a doctor and was booked off work for at least one full work shift). The net result was as follows:

- Medical cases – indirect costs to direct costs ratio was 0.85
- Lost workday cases – indirect costs to direct costs ratio was 0,23

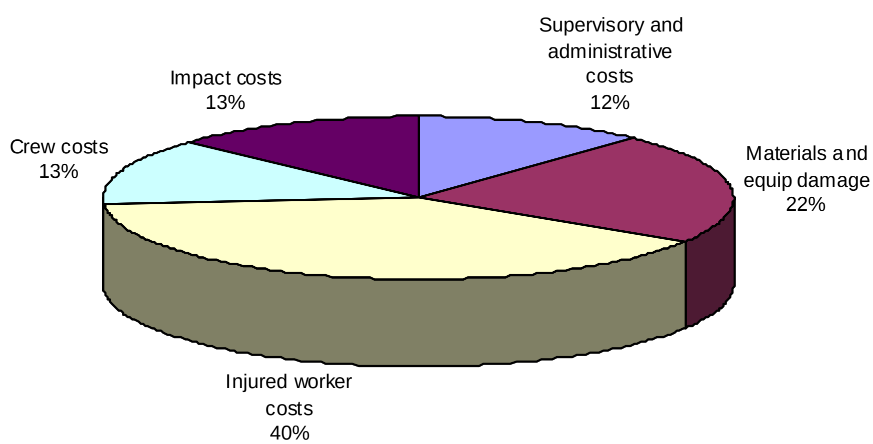


Figure 6. Job-site cost breakdown of medical case injuries

(Adapted from Hinze, 2006:72)

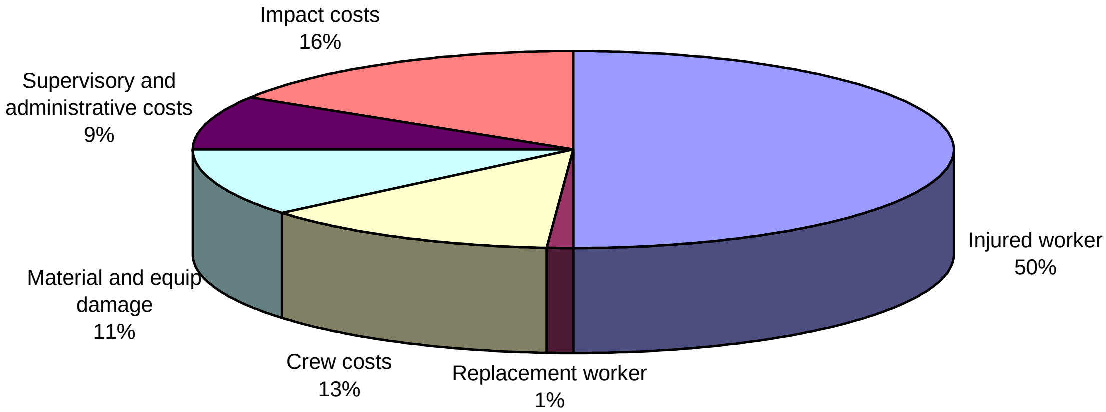


Figure 7. Job-site cost breakdown of restricted-activity or lost workday cases (Adapted from Hinze, 2006:72)

Because indirect costs are difficult to quantify they are generally ignored. It can also be argued that company management would prefer to report on accident costs being low, as any other result would prove that their management programmes are ineffective and costing the company unnecessary sums of money. The process of tracking the direct and indeed the indirect costs of an injury must begin with a detailed, structured accident investigation, co-ordinated by a competent accident investigator. Accident investigations are often superficial leading to the causes not being suitably identified and the accident costs not being investigated and accurately calculated. The process of 'learning from an accident' with the aim of preventing it from occurring again becomes limited. By being able to show management what an accident costs the company, even conservatively, will go a long way in convincing them to invest in health & safety programmes.

2.10.3 Injury cost models

As with accident causation models or theories, injury cost models serve to explain the relationship of different variables to the dependant variable being tested - in this case, site indirect injury costs (Hinze, 2006). The two preferred models put forward by the researchers from CII and the University of Washington (1991), one for medical cases and one for lost work shift cases, showed that the equations used successfully explained 79% of the indirect injury costs for medical cases and 81% of the indirect costs for lost work shift cases. The models are briefly described below:

- Site indirect costs (medical cases) = $150 + $15F + $30H + $100A
  F = the number of hours lost by injured worker to receive follow up care
  H = the number of hours lost by the injured worker on the day of the injury
  A = the number of hours spent by the administrative and supervisory personnel to assist the injured worker on the day of the injury
  Then, to calculate the total indirect costs, multiply them by 1.4.

- Site indirect costs (lost work shift cases) = $625 + $20F + $20H + $50V
  F = the number of hours lost by injured worker to receive follow up care
  H = the number of hours lost by the injured worker on the day of the injury
  V = the number of hours spent by administrative personnel to investigate the injury
  Then, to calculate the total indirect costs, multiply them by 9.

It makes sense for an organisation to adopt a systematic approach when attempting to quantify injury costs. The approach should allow for cost estimates to be made available to site and company management as soon as possible after the injury occurrence so that effective interventions can be introduced as soon as possible, thus preventing a similar injury from taking place on the site or for that matter within the company. Imagine if together with your company's injury alert notice, you send out the estimated injury cost to company, categorised into the various categories and values, based on the relevant injury cost model – wouldn't this increase the awareness of management towards injuries and ultimately health & safety. If this information could then be sub-divided into older and younger worker categories then management and other decision makers could be made aware of the importance of reducing injuries to older workers bearing in mind the skills they hold and the higher costs born per injury as indicated in the research material reviewed.

2.10.4 The cost of construction health and safety

The challenge of effective management of health & safety lies in balancing the cost of preventing incidents and injuries against the resultant costs of the consequences of potential incidents and injuries (Bamber, 1994). The ultimate goal would be a healthy, safe workplace that is more profitable and therefore sustainable.

Mselle (1997) categorised the cost of health & safety into pre and post accident costs. The pre-accident costs take into account the investment that a company makes in health & safety with the aim of eliminating, reducing and/or controlling accident risks. Examples of pre-accident costs are:

- Planning the job taking into account specific risk management techniques;
- Health & safety training;
- Personal protective clothing and equipment;
- Employment of health & safety personnel and supervisory staff; and
- Workman's compensation insurance, contractors all risk cover, asset insurance.

Post-accident costs, as described earlier can be categorised into direct and indirect costs and reflect the cost to company of accidents.

Although this research will not attempt to investigate the pre-injury costs related to older worker injuries, such research may produce findings that could be useful to companies who are serious about effectively managing their older workers.

2.11 Older construction workers and training

"An increase in the quality and amount of safety training should have the desired effect of lowering accident rates, increasing productivity, and decreasing operating costs in the construction industry" (Lew and Carpenter, 1997: 121).

As was pointed out by the various accident causation theories, injuries are a combination of primary causes such as the unsafe behaviour or personal act that leads directly to the accident occurrence and the upstream deficiencies like inadequate health & safety procedures and policies, lack of supervision, incorrect placement of workers, lack of incentives for positive safe behaviour and inadequate training to name a few.

One of the hypotheses of this study requiring testing is that older workers receive less training than their younger counterparts. The specific objective is to investigate the relationship between lower literacy levels, education and the likelihood of injuries sustained by older construction workers so that improved target related safety and health training may be implemented. Smallwood (1995) and Wilson (1989) both found that health and safety training at all levels of workers and management was lacking and that only a minority of construction personnel received health & safety related training.

Zwerling and Sprince (1996) found that the lower the level of education of a worker, the higher the risk of injury. This could be due to a few factors: workers with less education remain ‘in the front line’ for longer and are therefore exposed to higher risk activities for longer; the training they receive is not well understood due to their limited levels of literacy; instructions and safe work procedures are not easily understood.

In South Africa, the vast majority of construction labour is migrant and unskilled due mostly to the legacy of Apartheid, which suppressed education and skills within the black population. The vast majority of older workers in the construction environment are therefore uneducated or at best poorly educated, with a related low level of literacy (Deacon et al, 2005). Fuller, Liang and Hua (1996) found that the older the worker, the lower the level of literacy because of lower average levels of education in the past. It was also found that older workers received less safety and health related training compared with their younger counterparts (Patrickson and Hartmann, 1995). A related risk factor in the South African work environment is the fact that the unskilled Black African workforce is not well conversant in English, which is the construction industry’s language of choice, be it due to past inequalities or present and future globalisation. A similar problem was identified by Dooley (2002) who found that Hispanic migrant workers in the U.S.A. were prone to high levels of fatal injuries – many of these workers did not speak English and were not able to understand instructions and safety information imparted to them.

The first step is to recognise that older workers in general have lower levels of education and therefore lower levels of literacy i.e. reading and writing skills. In the South African example as with many other countries now, due to the opening of borders and the creation of regional trading blocks, language is a real barrier when it comes to understanding instructions and information. There may very well be an inverse relationship between poor language mastery and construction injuries (Hinze 2006; BLS, 1991 in Smallwood and Hart, 1998).

The second step is to assess what training is needed by what workers and how best the information should be imparted so that the outcomes realise the most favourable results.

The final result should be to achieve a high level of understanding of the safety and health information with an ultimate realisation of lower injuries to older workers and lower injury costs (Smallwood, 1997).

2.11.1 Types of construction related health and safety training

Training on a construction site begins with an inaugural health & safety induction session, which is supposed to be project specific and meant to impart to the workers basic site rules and procedures and serves to familiarise workers with their surroundings. Health and safety awareness training (tool box talks and training on specific site activities based on risk assessments and safe work procedures) is ongoing informal training and should concentrate of task specific hazards and safety measures and should take place regularly, but specifically before new tasks are performed. Then there is specific health and safety training for site supervisors, health and safety representatives, first aiders, health and safety officers, etc. The Construction Regulations promulgated in 2003 make reference to over forty 'competent' individuals. These individuals need to be trained in their respective portfolios and include the following examples: construction vehicle and mobile plant inspector, portable electrical tool inspector, excavation inspector, and formwork and support work supervisor and inspector, to name just five.

Smallwood and Hart (1998), reported that education and training is divided by the International Labour Organisation (ILO) into three categories: cognitive (knowledge), psychomotor (professional skills), and affective (attitudes and values).

Researchers agree that training will not always necessarily change behaviours, however it serves as an essential element to triggering the process of change since it provides the knowledge by which change can be made (Smallwood, 1997; Lew and Carpenter, 1997; Jaselskis, *et al*., 1997). The Occupational Health & Safety Act, 85 of 1993 mandates the employer (contractor) to provide the necessary information and training to ensure the health and safety of its workers. More specifically, contractors are required to make employees conversant with the hazards to their health & safety as well as the precautionary measures that should be taken to eliminate the risks associated with the hazards identified (Occupational Health & Safety Act, 1993; Smallwood and Hart, 1998).

2.12 Chapter summary

The construction industry needs to prioritise health and safety if it wants to reduce incidents and injuries to an acceptable level. The ultimate goal of construction companies should be to eliminate all incidents and therefore all injuries.

Older construction workers make up an important sector of this construction workforce and require special attention should they be retained as a productive, efficient cohort in an industry fraught with health and safety risks and difficult, challenging working environments.

A knowledge and understanding of how accidents occur should include an insight into not only the events leading directly to accidents, but more importantly the upstream shortcomings which act as the triggers of such accidents. These upstream events often take the form of company or project management failures such as a lack of sufficient health and safety training, a lack of competent supervision, an incorrect allocation of skilled workers to job tasks, and inadequate health and safety resources allocated to site, to name a few.

Further to the injuries themselves, the related costs borne by industry are prohibitive and hold the key if management and other decision makers are to be persuaded of the importance of health & safety. This is why an analysis of both the direct and indirect injury costs becomes an important tool. The costs of older worker related injuries compared with the injuries of their younger counterparts would bring to light any differences thereby indicating where management action is most required. The literature purported that older workers although not necessarily being injured more often than younger workers, sustained more serious injuries, which led to higher injury costs and more time off work due to slower recovery rates. It was however not conclusive from the literature whether older workers had a higher incidence of fatal injuries.

Should older worker injuries be successfully eliminated, it is important to identify the events leading to these injuries, the nature or types of injuries occurring, and the bodily locations being affected. It was apparent from the literature that certain types of injuries seemed to be more prevalent among older workers, these included: back injuries and general injuries related to the bones and joints. Falling from ladders seemed to top the list of events leading to older worker injuries. By analysing these sets of information, it should become apparent what preventative measures and management interventions will be required.

Finally, the literature study indicated that older workers had in general, a lower level of education and literacy compared with their younger counterparts and that they received less ongoing job related training (including health and safety training).

Related research done within other industries was also gathered and reviewed with the aim of comparing such findings.

In conclusion, it was evident that research on older worker injuries in the construction sector was limited and that most research found was directed at health related issues. Literature on older worker injuries in the South African construction environment was even more limited.

CHAPTER THREE
RESEARCH DESIGN

3.1 Introduction

The research study aims to test whether older construction workers suffer a higher risk of work-related injuries, whether these injuries are more serious and the associated costs higher compared with their younger counterparts.

A combination of quantitative and qualitative methodologies were utilised to collect the data necessary to test the hypotheses and arrive at the objectives put forward.

The validity of the findings is primarily based on a good understanding of basic statistics with the output being accurate injury statistics analysis, and the design of an effective set of research instruments being the qualitative questionnaires aimed at construction workers and site managers.

The chapter aims to explain the research methods used, the data collection techniques and analysis strategies as well as limitations encountered. The statistics analysed and data gathered by way of the questionnaires will be used to formulate conclusions out of which meaningful, practical solutions can be recommended to the South African construction industry so that older workers can be effectively managed.

3.2 Type of study (design)

Research design focuses on the end product: what kind of study is planned and what kind of results are required (Mouton, 2001). The design is, therefore, the plan or blueprint of how the research will be conducted and needs to be devised in such a way that the research question is effectively answered.

The research questions are: Are injuries more prevalent among older construction workers, do these workers sustain certain types of injuries due to specific events with certain body parts being injured? Are the injuries suffered by older workers more severe, and are the costs of older worker injuries higher than for younger workers? In order to effectively answer these questions, the research was designed to use the following methods: subject literature review; analysis of injury statistics, and gathering information by way of questionnaires and interviews.

3.3 Research methodology

The methods used to gather research data will ultimately determine the meaningfulness of that data and therefore ultimately determine the level of success of the study (Leedy, 1993). A good understanding of research methods was therefore imperative, which meant that a fair amount of associated literature had to be reviewed and studied.

"Research methodology is the 'how' of collecting data and the processing thereof" (Brynard and Hannekom, 2006:35). The two basic methodologies adopted by researchers are either quantitative or qualitative in nature, or a combination of both.

The study involved a combination of these two data collection methods, which included the analysis of existing injury statistics databases, being the quantitative part, and the administration of questionnaires and personal interviews being the qualitative part. The strategy of combining the quantitative and qualitative research methods to answer the research objectives, also known as triangulation is based on the premise that combining methods minimises the inherent limitations of using a single method (Patton, 2002). Example: The cost of injuries is higher among older workers compared with younger workers – hypothesis. The quantitative method of attempting to answer this statement would be the injury investigation of a group of workers over a period of time and comparing these injuries to the workman's compensation injury claims data for the same group. The data however only includes direct injury costs. In an attempt to ascertain the 'real' costs of such injuries, the indirect, unquantifiable costs also have to be taken into account. This is done by making use of related theories put forward in the literature as well as by questioning focus groups within the industry concerned i.e. construction managers and construction workers.

The results obtained from the research methods are required to test the hypotheses proposed at the outset of the study with a view to increasing the knowledge base in the field of construction injury management and more specifically the management of injuries to older construction workers.

Primarily, the type of research is one of analysis of analytical data sets made available by the construction industry so as to draw correlations between data for example the correlation between the age of workers and the cost of injuries sustained by that group of workers. In order to build on the statistical evidence, descriptive information is also gathered to support or reject the hypotheses of the study.

3.3.1 Research objectives

Effective design of the research instruments requires a good understanding of the data collection framework, underpinning theories, and of course a clear set of research objectives.
As set out in chapter one, the research aimed to address the following objectives:

- The first objective is to determine what construction work related injuries are more common among older workers and the correlation of the causes of these injuries with body parts affected, age of workers and job description.
- The second objective is to examine the relationship between the severity of the injuries sustained by construction workers and their age to establish what tasks should be avoided by older workers.
- The third objective is to establish the nature of the relationship between injuries to older workers and their consequent direct and indirect costs with the aim of convincing Employers that improved worker protection plans should be implemented to reduce injury costs.
- The fourth and final objective investigates the relationship between lower literacy levels, education and the likelihood and severity of injuries sustained by older construction workers so that improved target related safety and health training may be implemented.

3.3.2 Data collection instruments

3.3.2.1 Secondary data collection

Before the research topic was finalised, research literature was sourced and reviewed to gain a basic understanding of the topic. The hypotheses were then compiled and the objectives set. An extensive review of existing, related research literature was then undertaken to gain a thorough understanding of the pertinent topics, namely: construction injuries; costs of injuries; and older workers in construction. The literature included textbooks, academic journal articles, research theses on the subject, and research papers published in conference proceedings.

3.3.2.2 Primary data collection

Data collected by the researcher him/herself is termed the primary data (Brynard and Hannekom, 2006).

Two sets of statistics were analysed:

- The first set was the injury statistics of a large construction company involved in large-scale building and civil construction work and fits the description of a typical 'principal contractor' employing over 1000 hourly-paid employees at any one time. The company operates nationally as well as outside the boundaries of South Africa, however the statistics obtained were for its Western Cape division alone. The data represented 525 work related injuries for the period 1998 through 2005.
- The second set of statistics was sourced from the only private workman's compensation insurer licensed by the Department of Labour to cater for the construction injury (Federated employer's Mutual Assurance Company). The purpose of gathering these statistics was to analyse the costs of construction related injuries and to draw a correlation between age and injury costs.

Descriptive questionnaires:

It was decided that in order to achieve the objectives of the research study, further information would be required over and above the quantitative analysis of injury and cost data available in the statistical data sets. Two separate questionnaires were therefore developed:

- The first questionnaire was designed with the aim of gathering information by means of a structured interview.
- The second questionnaire was also 'structured' in nature however information would not be gathered by way of personal interviews but simply by asking respondents to answer the questions and return the results.

3.3.3 Questionnaire design

Research tools are what researchers need to use to derive meaningful conclusions from their data (Leedy, 1993). The five general tools of research are: the library; the computer; measurement techniques/instruments; statistics; and the final research report.

The design of the questionnaires included a combination of closed questions that required a 'tick box' with limited responses, as well as open questions where respondents were required in certain instances to clarify their responses. The questionnaires included questions designed to extract the following information:

Questionnaire aimed at construction workers –

- Personal and demographic data including inter alia: age; employment history; and occupation;
- Personal data on education levels and language proficiency;
- Personal data related to types of injuries sustained, numbers of injuries sustained, events leading to the injuries, body parts affected, and severity of injuries;
- Data related to occupational health interventions experienced during employment in construction, training received, and whether training had ever been refused.

Questionnaire aimed at construction site managers –

- Managers' perceptions of older workers with regard to: what is an older worker and what is their perceived level of productivity;
- Managers' perceptions of older worker injury proneness and injury costs;
- Whether the site manager is aware of any company policies aimed at older workers such a training, medical programmes, etc.;
- Managers' perceptions of the value of older workers to the construction industry and their level of safety when compared with their younger counterparts;
- Managers' perceptions of what the pensionable age should be.

The questionnaires were based on instruments previously used for similar research and were designed around the research objectives specific to this study so that the objectives could be satisfactorily achieved. In preparation of the questionnaires, preliminary tables were designed to ensure that as far as possible the objectives of the research as well as the hypotheses remained central to the research questions.

Table 7. Preliminary table: construction worker sample

No.	Proposed question	Objective	Data needed
1	What is your age?	1	Older worker ages
2	What is your trade?	1	Older worker trades
3	How long have you been involved in Construction?	1	Period in construction
4	What is your level of education?	4	Education level
5	Can you read or write in your home language?	4	Literacy level
6	Can you read or write in English?	4	Literacy level
7	Have you sustained any construction related injuries since the age of 40?	1	Types of injuries
8	What injury was the most severe – over 40?	2	Severity of injuries
9	Have you sustained a back injury since the age of 40?	1	Types of injuries
10	When last have you undergone classroom health & safety training?	4	H&S training received
11	When last have you undergone skills or other job related training?	4	Skills training received
12	When last have you been for a work related medical?	3	Work medical undergone

Table 8. Preliminary table: construction manager sample

No.	Proposed question	Objective	Data needed
1	Who do you consider an older worker? Age	1	Perception of older worker
2	Are certain injuries specific to older workers? If so what are they?	1	Perception of injury specificity
3	Do you think older workers are more prone to injury?	1	Perception of injury susceptibility
4	Do you think older workers sustain more serious injuries than younger workers?	2	Perception of injury severity
5	Do you think that the cost of injuries on average is higher among older workers?	3	Perception of injury cost
6	What do you think the average cost of a construction injury is? R1 - R500 R501 – R1000 R1001 – R2000 R2001 – R3000 R3001 – R4000	3	Perception of injury cost - general

7	Do you think older workers undergo less or more H&S training than younger workers and why?	4	Training to older workers
8	Do you think older workers undergo less or more skills training than younger workers and why?	4	Training to older workers

3.4 Reliability and validity

Reliability is synonymous with dependability, consistency, accuracy, and predictability. That is the research instrument used should realise the same or very similar data when used again under similar conditions. Validity on the other hand is the ability of the research instrument to measure what it has been designed to measure. In an attempt to further define research validity, a list of criteria has been developed (Bless and Higson-Smith 1995: 82, 136-139 in Brynard and Hannekom, 2006):

3.4.1 Content validity

This refers to the correctness and appropriateness of the questions included in the questionnaire or interview. A preliminary interview was conducted with a construction worker and a construction manager to test the validity of the questions. Changes had to be made to the worker questionnaire.

3.4.2 Criterion-related validity

Criterion validity serves to check whether the instrument selected actually measures what it is supposed to measure. A similar instrument utilised by researchers in India, deemed to be valid was used as the basis for the worker questionnaire. No similar instruments were found for the managers' questionnaire.

3.4.3 Construct validity

It was felt that the degree to which the questionnaires answered the hypotheses, objectives and topic in question was satisfactory bearing in mind that statistical data would also be analysed as the primary source of evidence.

3.4.4 Face validity

Due to the researcher's day-to-day involvement in the construction industry as an occupational safety & health consultant and previous employment as a company safety & health officer, the respondent groups were well understood. The face validity was therefore maintained.

3.4.5 External validity

The data collected is seen to be applicable to other researchers conducting similar studies and is therefore representative.

3.5 Preliminary investigation

The study builds on preliminary research conducted by Haupt and Smallwood (2003) after which certain research options were made available.

An initial investigation of the injury statistics recorded by the construction company concerned was undertaken to verify whether the data required for the research was in fact being captured. Due to past interactions with the company and after the preliminary investigation it was determined that the injury data was accurate and representative. The information required was the following: age of injured person; the injured person's trade (occupation); type of injury sustained; event leading to the injury (otherwise termed the cause); and body part affected. The investigation revealed that all the information was in fact being captured on a monthly basis and was readily available.

The costs associated with these injuries were however not readily available but were being captured by the company's workman's compensation insurer. A request was lodged with the regional manager of the insurance company to access the injury claims records. Permission was granted. Detailed injury claims costs were being captured and a typical spreadsheet was investigated to ascertain whether the information required for the research was readily available. The preliminary investigation indicated that the relevant data was in fact available.

The pilot study was completed after which research topic was finalised, namely: older construction workers – a study of related injuries, underlying causes and estimated costs.

3.6 Research population

The research topic determined the selection of the population to be sampled, namely: injured construction workers (statistical data bases – construction company and workman's compensation insurer) and construction worker – interviews. It was also decided that construction site managers active in the industry could add valuable information and opinions on the subject and would need to be questioned on their perceptions and opinions so as to gather the necessary information to answer the research question effectively and reject or not reject the hypotheses.

3.7 Data collection

Construction worker injury data was gathered by way of accessing the injury database of a large construction company. This would allow for an analysis of older worker injury types, body parts affected and events leading to the injuries. This specific construction company was approached because of the detailed nature of the injury data collected over the past ten years. Most of the parameters required for the research were available as part of the injury database. The company agreed to make its injury database and statistics available. The only parameter not directly available from the injury database was the ages of the injured persons. This critical information was however sourced from the company's human resources department who keeps an injury register in which the identity numbers of the injured persons are recorded. The identity numbers were then reworked into ages and included in the database. At this stage the injury database and supporting information for the period 1998 through 2005 were ready for analysis.

One of the parameters not recorded by the construction company in question were the costs of the worker injuries. This information then had to be sourced from the company's workman's compensation insurer who kept accurate injury claims data. The insurance company is a registered provider in terms of the Compensation for Occupational Injuries and Diseases Act and offers a service exclusively to the construction industry. It was decided that injury claims data for the period 2002 would be collected for the geographical area of the Western Cape and would include all injury claims, not only those for the company in question. The number of claims processed was 1492. It must be understood that the injury claims data represented only the direct injury costs i.e. medical costs, pension pay outs, disability claims and lost work shifts (at 75% of the injured worker's wage). The insurance company in question was approached by means of contacting its regional director who together with his information technology division in Johannesburg compiled a detailed spreadsheet in accordance with the parameters set out in an e-mail to him. The parameters were: injuries for the period 2002; age of injured worker; trade of injured worker; type of injury sustained; event leading to injury; body part affected; cost of the injury (medical cost, pension pay out, disability claims, and lost work shifts claimed).

It was further decided to interview construction workers of all ages and from various construction companies with the aim of ascertaining valuable personal information with respect to their perceptions vis a vis injuries; level of education; exposure to training and other management interventions. The information was gathered by way of a questionnaire designed for the purpose and it was decided to make use of project-based construction safety & health officers who had an underpinning knowledge of health & safety, including an understanding of injury causation among other proficiencies. Project safety & health officers were identified (7), operating on 6 different construction sites within the Cape Peninsula geographical area with the aim of having seventy interviews conducted. An appointment was then made with the officers after consulting with their respective project managers. Once permission was granted by the site managers the research topic and objectives were discussed and questionnaire explained. The process involved running through the questionnaire, question by question ensuring that every question was thoroughly understood. The process took in the region of thirty minutes after which 10 copies of the questionnaire were left in the possession of the H&S officers. They were given 10 working days to interview the 10 workers and return the completed questionnaires. The officers were also advised to contact the researcher should they require any support while conducting the interviews.

Further to the 'worker' interviews, construction site managers also formed part of the data collection process. Relevant information was gathered from them by way of questionnaires sent via e-mail. The e-mail contained an explanation of the research topic and objectives and had the questionnaire attached. Respondents could either complete the questionnaire and return electronically or print out and return via fax. It was made clear that all questions should be completed. Questionnaires were sent out to twenty-eight construction site managers. The respondents were also given a time frame of 10 working days in which to complete and return the questionnaires.

3.8 Data analysis method

The quantitative data was analysed using a combination of manual methods of tallying up the various data as well as utilising the Statistical Package for the Social Sciences (SPSS) software package. The injury data gathered from the construction company for the period 1998 through 2002 were analysed using SPSS while the injury costs data from the insurance company for the period 2002 and the company injury data for the period 2003 through 2005 were analysed manually. The qualitative information gathered by way of the interviews and questionnaires were analysed manually.

3.9 Limitations of the study

This section provides information regarding the limitations identified during the study.

3.9.1 Literature limitations

The literature specific to the subject of older construction worker injuries and associated costs was seen to be limited. Previous research on the topic was not widespread.

3.9.2 Participation in the research

The injury data collected was from a single construction company. The company was, however, one of the largest operating in the region and was involved in both building and civil construction and was therefore seen to offer a representative population for the study. The injury costs data was readily accessible from the workman’s compensation insurance company. The 6 construction sites approached (three different companies), were all willing to allow the worker interviews to be conducted on their sites. The project safety & health officers who facilitated the worker interviews were offered a re-imbursement of R10 for every interview conducted. They were each expected to conduct 10 interviews on their respective sites. Questionnaires were disseminated to twenty-eight site managers, from 9 different companies via e-mail with two questionnaires being hand delivered to site managers who had no e-mail or fax facility on site.

The response rates were as follows:

- A total of 60 construction worker interviews were successfully completed and returned; and
- A total of 18 construction site managers completed questionnaires and returned them successfully.

3.9.3 Language barriers

When conducting the worker interviews, it was foreseen that language could pose a barrier. It was therefore decided that Xhosa speaking safety & health officers would interview Xhosa speaking workers, English speaking H&S officers would interview English workers and Afrikaans speaking H&S officers would interview Afrikaans speaking workers. Site managers were all proficient in English and Afrikaans so the questionnaires were compiled in English.

3.9.4 Geographical constraints

The study was limited to the geographical region of the Cape Peninsula, Western Cape, South Africa for the purpose of the worker injury data, worker interviews and site manager population. The injury costs data sourced from the insurance provider was also for the Western Cape (Cape Town regional office).

3.9.5 Competence of the questionnaire administrators

The project based health and safety officers were all previously trained in occupational health and safety and had construction site experience. A work relationship had been built between the officers and the researcher over a period of time and their knowledge and understanding of the subject was seen to be adequate.

3.10 Ethical considerations

The construction company making its injury database available shall remain anonymous and all information gathered shall remain confidential.

Permission was received from the construction companies who participated in the worker interviews. It was explained to the workers undergoing the interviews that they would remain anonymous and that all information would be treated as strictly confidential.

The questionnaires made no reference to the name of the worker or manager. The questionnaires were merely numbered, with the H&S officer who administered the interview placing his or her name on the questionnaire.

3.11 Chapter summary

This chapter served as a synopsis of the research design and detailed the methods followed to answer the research question, prove or disprove the hypotheses and reach the objectives set out in the research proposal. The subject literature was found to be limited although sufficient for the purpose of the research. The quantitative data gathered was found to be representative for both the injured workers and injury costs populations. The qualitative questionnaires and interviews were designed using accepted research principles and a strict protocol was followed to collect the information. The following chapter presents the data analysis and interpretation of the findings.

CHAPTER FOUR

DATA ANALYSIS, INTERPRETATION AND FINDINGS

4.1 Introduction

The purpose of this chapter will be to present the analysis of the data collected from two databases, during worker interviews and from surveys. The results will also be interpreted and discussed.

The chapter is divided into six sections in accordance with the five research instruments utilised, namely:

- the construction company injury database;
- the construction industry workman's compensation insurer's claims database;
- the construction worker interview; the construction manager questionnaire; and
- the occupational health practitioner questionnaire.

The final section is the chapter summary.

4.2 Injuries to older construction workers

In order to achieve the objectives of this study, the records of injuries were analysed of a large construction company involved in building and civil construction work in the Western Cape. This company is a typical principal contractor employing between 1,500 and 2,000 hourly-paid employees at any one time, depending on the volume of construction work being undertaken. The cases investigated were restricted to only those hourly-paid construction workers employed on a project to project basis – as soon as a construction site comes to a close, the employees are deployed to the next site or laid off if there is no other work. Data were extracted for the period 1998 through 2005. The data were divided into injuries to two age groupings, namely older workers (> 40 years old) and younger workers (<40 years old). The data were analysed using a combination of the SPSS (Statistical Package for the Social Sciences) statistical package and manual analysis. The objectives of this analysis were to investigate whether there were any differences between the types of injuries suffered by older workers compared with their younger counterparts as well as the events leading to these injuries, the body parts affected, and severity of the injuries.

4.2.1 Age distribution of injuries

The sample comprised of 525 workers who had been injured while working on construction sites of whom 240 (45.7%) were older workers as defined. The mean age of the sample was 38.8 years, younger workers 29.6 years and the older worker cohort 49.6 years. The median age for the younger workers was 27.5 years and for the older workers, 49 years. The median for the sample as a whole was 35 years Ages ranged from 18 years to 68 years. The age distribution of both younger and older workers is shown in Table 9.

Table 9. Age distribution (1998-2005)

	Younger workers		Older workers	
Age category	Frequency	Percent	Frequency	Percent
0-29	141	49.5	-	-
30-39	144	50.5	-	-
40-49			128	53.3
50-59			94	39.2
60+			18	7.5
Total	285	100.0	240	100.0

4.2.2 Annual distribution of injuries

The distribution of injuries in each of the years 1998 through 2005 is shown in Figure 8.

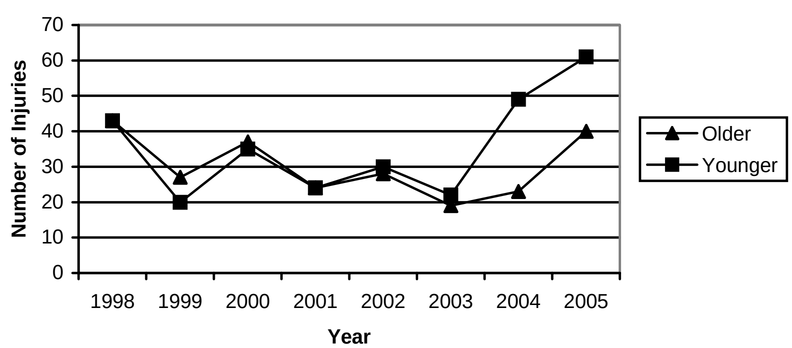


Figure 8. Annual distribution of injuries

There is an overall downward trend in the number of injuries for each year – relative to both younger and older workers from 1998 to 2003 with a sharp increase in injuries from 2004 through 2005. The rise in injuries is probably correlated to the rise in construction activity experienced in the Western Cape during that period. Older workers experienced marginally more injuries than their younger counterparts in 1999 and 2000. Younger workers however experienced a much higher number of injuries in 2004 and 2005, possibly indicative of the growing skills shortage and more inexperienced younger workers entering the sector. However more investigation is required to verify this extrapolation.

4.2.3 Occupation category distribution

Just under half (49.7%) of the sample was unskilled workers who made up 61.1% of younger workers. The older worker cohort had the largest percentage of injured workers in the 'skilled' category with unskilled workers making up 36.3%. This finding may be reflective of the situation that a larger proportion of older worker are skilled workers compared with younger workers who are for the most part unskilled. Table 10 shows the distribution of occupations.

Table 10. Occupation category distribution (1998-2005)

	Younger workers		Older workers	
Category	Frequency	Percent	Frequency	Percent
Unskilled	174	61.1	87	36.3
Semi-skilled	67	23.5	56	23.3
Skilled	42	14.7	94	39.2
Other	2	0.7	3	1.3
Total	285	100.0	240	100.0

The distribution of occupation categories in each of the years 1998 through 2005 is shown in Figure 9.

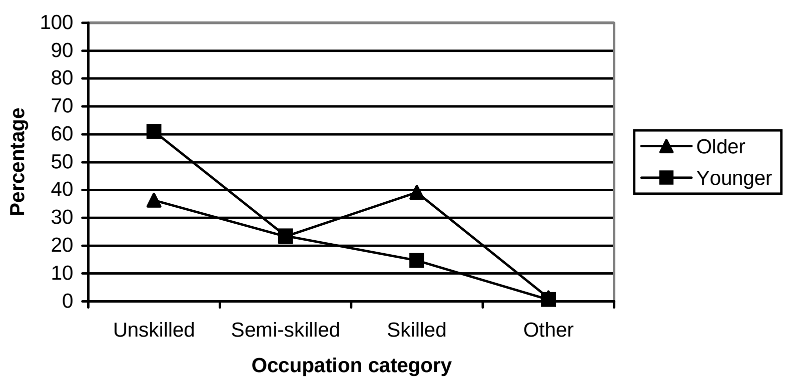


Figure 9. Occupational category of workers (Company sample)

4.2.4 Events leading to injuries

The most common events leading to injuries, to both younger and older workers was "struck by", namely 33.7% and 42.9% respectively. The next most frequent events leading to older worker injuries were:

- "Striking against" (13.8%); and
- "Caught in, on, between" (11.3%).

For their younger counterparts these were:

- "Caught in, on, between" (20.0%); and
- "Striking against" (10.5%).

This finding suggests that there is very little difference between the most common events leading to injuries among older workers and their younger counterparts. What differs is their relative frequencies These results are shown in Table 11.

Table 11. Events leading to injuries (1998-2005)

	Younger workers		Older workers	
Cause of injury	Frequency	Percent	Frequency	Percent
Struck by	96	33.7	103	42.9
Caught in, on, between	57	20.0	27	11.3
Striking against	30	10.5	33	13.8
Accident type n.e.c.	27	9.5	13	5.4
Slip or over-exertion	26	9.1	22	9.2
Fall onto same level	23	8.1	21	8.8
Fall onto different levels	20	7.0	19	7.9
Contact with temperature extremes	4	1.4	1	0.4
Contact with electric current	2	0.7	1	0.4
Total	285	100.0	240	100.0

4.2.5 Nature / type of injuries

The data in Table 12 suggest that the most common forms of injuries to both younger and older workers were superficial wounds such as bruising, lacerations and burns, followed by penetrating wounds such as eye injuries and 'trod of steel wire nail'. For older workers bony injuries such as fractures, and muscle injuries such as strains (back, neck) and torn ligaments were the next most frequent causes of their injuries. Fractures were also the next most frequent cause of injuries to younger workers. Muscle injuries were 50% less likely among younger workers. Again the findings suggest that the nature of injuries is not necessarily age-related.

Table 12. Nature/type of injuries (1998-2005)

	Younger workers		Older workers	
Nature of injury	Frequency	Percent	Frequency	Percent
Superficial wounds (e.g. Burn, laceration)	156	54.7	118	49.2
Penetrating wounds	60	21.1	53	22.1
Bony injury (e.g. Fracture)	23	8.1	25	10.4
Joint injury (e.g. Dislocation, sprain)	22	7.7	8	3.3
Muscle injury (e.g. Strain, torn ligament)	13	4.6	22	9.2
Multiple injuries	7	2.5	6	2.5
Injury to internal organ with no external open wound (e.g. Concussion)	4	1.4	6	2.5
Amputation or removal of organ	-	-	2	0.8
Total	285	100.0	240	100.0

4.2.6 Bodily location of injuries

The most likely body parts of older workers to be injured on construction sites were:

- Finger (17.5%);
- Eye (15.4%); and
- Trunk (11.6%),

while the most likely body parts of younger workers to be injured on construction sites were:

- Finger (23.9%);
- Eye (13.7%); and
- Foot (10.2%).

The high percentage of finger injuries sustained by both the cohorts may be an indication of skills shortage or mere inexperience together with the failure to wear hand protection such as gloves where necessary.

Trunk injuries included 9 back injuries (4 among older workers and 5 among younger workers), 9 injuries of the ribs, and 4 chest injuries. In the category ‘other’, 8 wrist injuries and 4 injuries of the ear (not noise induced hearing loss) resulted.

Table 13. Bodily location of injury (1998-2005)

	Younger workers		Older workers	
Bodily location	Frequency	Percent	Frequency	Percent
Finger	68	23.9	42	17.5
Eye	39	13.7	37	15.4
Foot	29	10.2	21	8.8
Trunk	22	7.7	33	11.6
Head	20	7.0	14	5.8
Leg	18	6.3	15	6.25
Multiple	17	6.0	16	6.7
Ankle	17	6.0	6	2.5
Arm	14	4.9	12	5.0
Other/unspecified	14	4.9	11	4.6
Hand	11	3.9	11	4.6
Shoulder	6	2.1	4	1.7
Knee	5	1.8	13	5.4
Neck	5	1.8	5	2.1
Total	285	100.0	240	100.0

4.2.7 Shifts lost due to injuries

The construction company’s injury data included an accurate summation of the shifts lost for every injury recorded (2002 through 2005). Five categories were used when analysing the injuries, namely: medical cases where no shifts were lost i.e. injured person required more than first aid treatment and returned to work without a full shift being lost; disabling injury where the injured person was off work for 1 to 3 shifts (incidentally this category is not claimable from workman’s compensation); disabling injury where the injured person was off work for 4 to 13 days; disabling injury where the injured person is off work for 14 days/shifts or more (these injuries are also named ‘reportable’ injuries in terms of the COID Act and have to be reported to the

Provincial Director of the Department of Labour); then the ‘still off’ category allows for injuries where injured person was still off at the time of analysis or where the total shifts lost was not known at the time of analysis. It must be noted that the injuries analysed did not include first aid cases.

Table 14 illustrates that the vast majority of injuries fall into the medical case category, namely 192 for younger workers (67.4%) and 186 for older workers (77.5%) respectively. Younger workers showed a much higher frequency of injuries in the ‘1-3 shifts lost’ category with 19 injuries (6.7%) compared with 5 (2.1%) for the older cohort. The ‘4-13 shifts lost’ category also indicated that the younger workers suffered more injuries in this category compared with the older cohort, 9.8% compared with 6.7% for older workers. The ‘reportable’ injury category (14< shifts lost) was noteworthy in that 9 (3.2%) injuries fell into the younger worker category compared with just 4 (1.7%) in the older worker group. The ‘still off’ category indicates that 64 (12.2%) injuries could not be classified due to the injured workers not having resumed work yet or simply that the shifts lost were not known at the time of analysis. Two injuries resulted in fatal outcomes, equally distributed between the younger and older groups.

Table 14. Injury categories (injuries per category 1998-2005)

	Younger workers		Older workers	
Shifts lost category	Frequency	Percent	Frequency	Percent
0 (medical case)	192	67.4	186	77.5
1-3	19	6.7	5	2.1
4-13	28	9.8	16	6.7
>14	9	3.2	4	1.7
Still off/unknown	36	12.6	28	11.7
Fatal	1	0.4	1	0.4
Total (injuries)	285	100.0	240	100.0

The distribution of injury categories for the construction company sample (1998-2005) is shown in Figure 10.

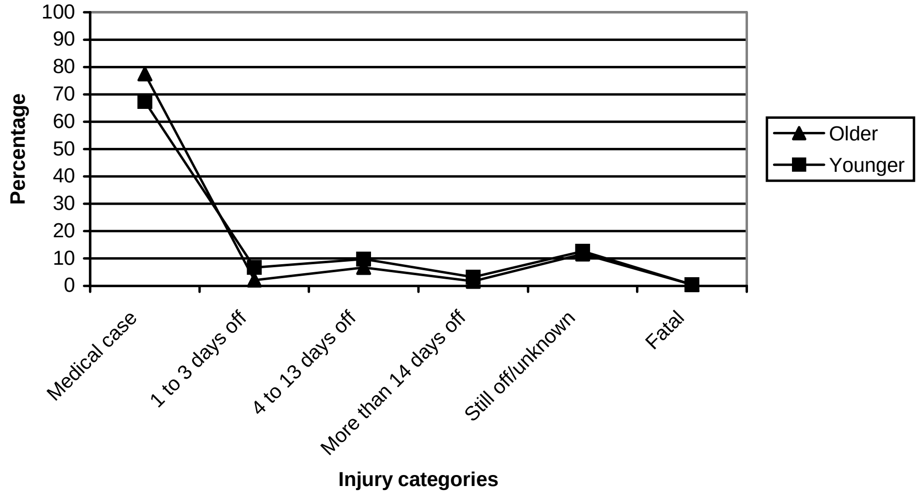


Figure 10. Injuries sustained per category (Company sample)

Table 15 sets out the number of shifts lost due to injuries in terms of the 6 'shifts lost' categories for the period 1998 through 2005. It is evident that younger workers suffer more lost days in the '1-3 shifts lost' category, 40 (19 injuries) compared with 12 (5 injuries) for older workers. Younger workers also lose more shifts in the '4-13 shifts lost' category with 200 shifts lost compared with 125 for older workers. The average days lost per injury in this category are however comparable, 7.1 for younger workers and 7.4 for older workers. Of the 4 older worker injuries categorised under '14< shifts lost', 132 days were lost, an average of 33 days off per injury. On the other hand younger workers sustained 9 such injuries averaging 70.2 days off per injury. It must also be noted that the two most serious younger worker injuries in this category resulted in 209 days and 137 days being lost compared with the most serious older worker injury resulting in 50 lost days/shifts. The most notable finding here is not that older workers seem to stay off work for longer due to their injuries as indicated in some of the literature (Stalnaker, 1998; Zwerling and Sprince, 1996). Rather, it is the converse, younger workers on average were off work for longer, namely 3.5 days compared with the older workers being off for 1.3 days, a difference of 2.2 days per injury.

Table 15. Shifts lost per injury category (days per category 1998-2005)

	Younger workers		Older workers	
Shifts lost category	Shifts lost	Percent	Shifts lost	Percent
0 (medical case)	0	0	0	0
1-3	40	4.6	12	4.5
4-13	200	22.9	125	46.5
>14	632	72.5	132	49.1
Still off/unknown	-	-	-	-
Fatal	-	-	-	-
Total (shifts lost)	872	100	269	100

4.2.8 Summary of construction company injury data

The analysis of the data showed very little evidence of event-specific injuries to older workers. A comparison worth making is with 'struck by' injuries where older workers sustained 103 (42.9%) such injuries compared with younger workers, 96 (33.7%). These numbers are high, reflective of the industry in general and no conclusive indication of being age-specific. 'Caught in, on, between' showed the inverse, with older workers sustaining 27 (11.3%) related injuries while younger workers were significantly more prone to this event with 57 (20.0%) related injuries.

The literature made reference to older workers being more prone to bony related injuries such as fractures (Hinze, 2005). In the study sample, bony injuries did not show any significant variance between older workers (25) and younger workers (23). No other indications of age-specific nature of injury were found. Closer investigation of injury records revealed four cases of noise-induced hearing loss – all among older workers. Silicosis and dermatitis cases were also only detected in the older group.

The most likely body parts to be injured were comparable between older and younger workers with minor notable differences except when it came to 'trunk', 'knee' and 'ankle' injuries. The 'trunk' injuries suggested a correlation between older workers and 'back' injuries. 'Knee' injuries are typical in older people and may be due to previous injuries or conditions. 'Ankle' injuries were considerably more prevalent among younger workers (17) compared with older workers (6). Further investigation may be necessary to determine the exact causes of these ankle injuries. Although head injuries totalled 34 (both cohorts), they were face- and forehead-related and not skull- and brain-related.

With regard to work shifts being lost due to injury it was significant that in total, 603 more days were lost due to younger worker injuries, when compared with older workers. The average days lost per injury were 1.3 for older workers and 3.5 for younger workers, a difference of 2.2 shifts per injury, equivalent to 14.4 hours.

In summary older construction workers sustain fewer injuries and lose less work shifts on average due to their injuries. It can therefore be concluded that older workers are prone to less severe injuries in comparison to their younger counterparts.

4.3 The cost of injuries to older construction workers

Older workers do not necessarily get injured more often, but they generally take longer to recover from their injuries resulting in the cost of their injuries being higher (Stalnaker, 1998). Serious occupational injuries involving death or disability increase with age while less serious injuries decrease (Stalnaker, 1998; Zwerling and Sprince, 1996).

The research involved analysis of two separate populations namely: the injury claims costs for the period1998 through 2002 involving 311 injury claims of the construction company investigated; and the injury claims costs of the construction industry for 2002 involving 1,492 injury claims in general as insured by Federated Employer's Mutual Assurance Company, a registered workman's compensation service provider to the construction industry in South Africa.

The objective was to determine whether older worker injuries resulted in higher costs and more time off work and more specifically to investigate what types of injuries, the events leading to such injuries and the body parts that resulted in the most costly injuries to older workers.

4.3.1 Cost distribution

4.3.1.1 Company population

The mean cost per injury for younger workers was R2,211 and ranged from a minimum of R0 to a maximum of R56,963. The mean cost per injury for the older workers was R2,689 and ranged from a minimum of R0 to a maximum of R46,115. The median cost of younger worker injuries was 27.5 years while for the older group it was 49 years. The median for the entire sample was 35 years. From Table 16 it is evident that most injuries to older workers cost between R500 and R999 (31.4%)

while most injuries to younger workers cost between R200 and R499 (32.9%). Further, 78.9% of younger and 73.5% of older worker injuries cost less than R999.

Table 16. Cost of injuries (Company sample 1998-2002)

	Younger workers		Older workers	
Cost category (Rands)	Frequency	Percent	Frequency	Percent
0	11	7.2	6	3.8
1-199	14	9.2	15	9.4
200-499	50	32.9	46	28.9
500-999	45	29.6	50	31.4
1000-1999	13	8.6	20	12.6
2000-2999	3	2.0	2	1.3
3000-3999	2	1.3	2	1.3
4000-4999	3	2.0	1	0.6
>5000	11	7.2	17	10.7
Total	152	100.0	159	100.0

4.3.1.2 Compensation insurer population

The mean cost per injury for younger workers was R3,243 and ranged from a minimum of R105.00 to a maximum of R179,932.65. The mean cost per injury for the older workers was R5,500 and ranged from a minimum of R170.20 to a maximum of R167,262.80. The median was R697.61 for the younger group and R928.37 for the older workers.

From Table 17 it is evident that most injuries to younger as well as older workers cost between R500 and R999 (32.3% and 26.8% respectively). Further, 65.3% of younger and 52.5% of older worker injuries cost less than R999.

Table 17. Cost of injuries (FEM sample 2002)

	Younger workers		Older workers	
Cost category (Rands)	Frequency	Percent	Frequency	Percent
0	-	0	-	0
1-199	48	4.7	11	2.4
200-499	290	28.3	109	23.3
500-999	331	32.3	125	26.8
1000-1999	156	15.2	105	22.5
2000-2999	45	4.4	30	6.4
3000-3999	30	2.9	10	2.1
4000-4999	18	1.8	6	1.3
5000-5999	14	1.4	8	1.7
6000-6999	9	0.9	6	1.3
7000-7999	4	0.4	0	0
8000-8999	5	0.5	8	1.7
9000-9999	6	0.6	3	0.6
10000-19999	34	3.3	18	3.9
20000-49999	22	2.2	16	3.4
50000-99999	9	0.9	9	1.9
>100000	4	0.4	4	0.9
Total	1025	100.0	467	100.0

4.3.2 Trade / occupation vs. cost

Table 18 sets out the trades of workers injured during 2002 as captured by the FEM database. The trade categories have been standardised by FEM. The thirteen categories used below do not represent all the categories used by FEM. Trades such as: foreman; operator; driver; manager; team leader; quantity surveyor; etc. were not included in terms of the definition of older worker as defined in Chapter 1.

Table 18. Trade / occupation vs. cost of injuries (FEM sample 2002)

Trade	Younger <40			Older >40		
	Injuries (%)	Cost (Rands)	Ave cost (Rands)	Injuries (%)	Cost (Rands)	Ave cost (Rands)
Labourer	832(81.2)	2,174,131	2,613.13	256(54.8)	1,167,695	4,561.30
Carpenter	57(6.9)	425,051	7,457.03	78(16.7)	433,375	5,556.08
Roofer	12(1.1)	11,099	924.91	17(3.6)	31,816	1,871.52
Electrician	42(4.1)	300,145	7,146.30	22(4.7)	87,509	3,977.68
Rigger	1(0.1)	454	454.00	7(1.5)	5,771	824.42
Tiler	3(0.3)	1,831	610.33	3(0.6)	1,704	568.00
Glazier	10(1.1)	62,763	6,276.30	6(1.3)	1960	326.66
Painter	24(2.3)	290,016	12,084.00	25(5.4)	288,685	11,547.40
Bricklayer	14(1.4)	19,254	1,375.28	30(6.4)	204,528	6,817.60
Mason	1(0.1)	1,117	1,117.00	8(1.7)	52,096	6,512.00
Plasterer	1(0.1)	273	273.00	2(0.4)	3,693	1,846.50
Plumber	26(2.5)	35,666	1,371.76	13(2.8)	294,109	22,623.76
Other	2(0.2)	2,141	1,070.50	-	-	-
Total	1025(100)	3,323,941	3,242.87	467(100)	2,572,941	5,509.51

Younger worker injuries represented 68.7% (1025 cases) of the total sample while the older workers represented 31.3% (467 cases). The category most injured in both cohorts was ‘Labourer’. This was not surprising bearing in mind that labourers, also termed general workers represent a large proportion of construction personnel. The next most represented trade, once again in both cohorts was ‘Carpenter’, with this trade comprising 16.7% of the older group.

The average cost of injuries for the younger workers was R3,242.87 compared with the older group where the average cost was R5,509.51. This finding supports the literature where older work injury costs are said to be higher due to recovery rates being slower and workers being off work for longer periods compared with their younger counterparts (Brooke, 2003, Work Cover Authority of NSW, 1994). The average cost per injury varied significantly between the two cohorts with older workers costing substantially more per claim (R5,509.51) compared with the average cost of a younger worker injury being R3,242.87. A difference of R2,266.62 per claim. The trades representing the highest average injury costs for older workers were plumbers (R22,623.76), painters (R11,547.40) and bricklayers (R6,817.60). Painters represented the trade with the highest average injury cost for younger workers (R12,084.00). Painters generally work in elevated work positions and falls from heights (fall on different level) could be the reason for these high injury costs in both cohorts.

4.3.3 Events leading to injuries vs. cost

The events leading to injuries can also be termed the causes of injuries. The eleven categories are the standard reporting categories as utilised by FEM.

Table 19. Events leading to injuries vs. cost of injuries (FEM sample 2002)

Event / cause	Younger <40			Older >40		
	Injuries (%)	Cost (Rands)	Ave cost (Rands)	Injuries (%)	Cost (Rands)	Ave cost (Rands)
Accident type N.E.C	4(0.4)	2,310	577.50	1(0.2)	459	459.00
Striking against	152(14.8)	295,358	1,943.14	62(13.3)	186,333	3,005.37
Struck by	511(49.9)	1,063,723	2,085.73	197(42.2)	993,706	5,044.19
Caught in/on/ between	69(6.7)	393,606	5,704.43	29(6.2)	122,866	4,236.76
Fall on the same level	33(3.2)	114,616	3,473.21	20(4.3)	30,923	1,546.15
Fall on different level	115(11.2)	1,128,672	9,814.54	80(17.1)	1,018,306	12,728.25
Slip or overexertion	91(8.9)	170,756	1,876.44	59(12.6)	132,494	2,245.66
Contact with temperature	15(1.5)	69,516	4,634.40	7(1.5)	5,172	738.86
Contact with electricity	7(0.7)	27,732	3,961.71	1(0.2)	5,080	5,080.00
Motor vehicle accident	16(1.6)	49,831	3,114.44	8(1.7)	57,312	7,164.00
Other	12(1.2)	8,583	715.25	3(0.6)	13,395	4,465.00
Total	1025(100)	3,324,703	3,243.61	467(100)	2,566,046	5,494.75

The events leading to the most injuries for both younger and older workers were: struck by; strike against; and fall on different level. 'Struck by' injuries include objects and materials falling onto workers from elevated positions. 'Striking against' injuries include such instances where a worker knocks his head, hand of knee against an object or structure. 'Fall on different level' is an event where a worker falls from one level or floor to another, usually in excess of 2.5m in height. This must not be confused with 'fall on the same level' where a worker trips and falls onto the same level or floor on which he is working or walking. The event category, 'Slip or overexertion' leads to such injuries as strains and sprains resulting in knee and back injures as well as ankle related injuries.

The event representing the highest average cost was the same for both groups, namely 'Fall on different level' costing R9,814.54 for younger workers and R12,728.25 for older workers. Motor vehicle accidents represented the event leading to the second highest average cost among older workers (R7,164.00).

4.3.4 Nature / type of injuries vs. cost

The categories represent the nine categories used when reporting the nature/type of injuries to FEM.

Table 20. Nature or type of injuries vs. cost of injuries (FEM sample 2002)

Nature / type	Younger <40			Older >40		
	Injuries (%)	Cost (Rands)	Ave cost (Rands)	Injuries (%)	Cost (Rands)	Ave cost (Rands)
Penetrating wounds	316(30.8)	354,757	1,122.64	131(28.1)	383,922	2,930.70
Superficial wounds	385(37.6)	632,081	1,641.77	154(33.1)	382,520	2,483.90
Multiple injuries	49(4.8)	737,275	15,046.43	32(6.9)	337,047	10,532.72
Internal organs	5(0.5)	19,521	3,904.20	-	-	-
Muscle injury	107(10.4)	210,126	1,963.79	72(15.4)	131,132	1,821.28
Joint injury	60(5.9)	235,691	3,928.18	31(6.6)	382,913	12,352.03
Bony injury	77(7.5)	861,467	11,187.88	34(7.3)	826,938	24,321.71
Amputation or removal of organ	10(1.1)	259,898	25,989.80	6(1.3)	93,985	15,664.17
Other	16(1.6)	14,451	903.19	7(1.5)	26,799	3,828.43
Total	1025(100)	3,325,267	3,244.16	467(100)	2,565,576	5,493.74

The nature of injuries responsible for the most injuries in both younger and older workers were ‘Superficial wounds’, ‘Penetrating wounds’ and ‘Muscle injury’. The category, ‘Bony injury’ represented the highest average cost for older workers (R24,321.71) while for younger workers the nature responsible for the highest average cost was ‘Amputation or removal off organ’ representing R25,989.80 on average. The average cost of bony injuries was also high for younger workers, however less than half the average cost when compared with older workers. This is significant given that the finding aligns with the literature and substantiates the medical claim that older workers take longer to heal (Hinze, 2005). Fractures and other bone related injuries are termed serious and necessitate lengthy periods of recovery. This is exacerbated in the older worker cohort. Amputations represented the highest average cost of injuries for younger workers and the second highest average cost for older workers which may be due to the high medical costs and resulting lengthy recovery time associated with these injuries. ‘Amputations’ was the least frequent type of injury to older workers.

4.3.5 Bodily location of injuries vs. cost

The 15 categories are in accordance with the FEM reporting criteria used.

Table 21. Bodily location of injuries vs. cost of injuries (FEM sample 2002)

Body part	Younger <40			Older >40		
	Injuries (%)	Cost (Rands)	Ave cost (Rands)	Injuries (%)	Cost (Rands)	Ave cost (Rands)
Head	66(6.4)	231,011	3,500.17	20(4.3)	226,295	11,314.75
Neck	9(0.9)	5,817	646.34	8(1.7)	6,728	841.00
Trunk	133(13.0)	443,855	3,337.26	80(17.1)	334,811	4,185.14
Shoulder	30(2.9)	126,591	4,219.70	15(3.2)	64,925	4,328.34
Arm	52(5.1)	251,155	4,829.91	14(3.0)	76,629	5,473.50
Hand	59(5.8)	261,316	4,429.09	40(8.6)	80,932	2,023.30
Finger	217(21.2)	509,961	2,350.05	83(17.8)	405,936	4,890.80
Wrist	24(2.3)	60,426	2,517.75	7(1.5)	50,507	7,215.29
Leg	70(6.8)	401,886	5,741.29	36(7.7)	266,062	7,390.61
Foot	86(8.4)	117,807	1,369.85	36(7.7)	140,589	3905.25
Knee	30(2.9)	100,393	3,346.44	31(6.6)	276,046	8,904.72
Ankle	39(3.8)	43,005	1,102.70	9(1.9)	121,940	13,548.89
Eye	142(13.9)	113,128	796.67	44(9.4)	117,265	2,665.11
Multiple	64(6.2)	656,051	10,250.80	42(9.0)	388,185	9,242.50
Unspecified	4(0.4)	2,296	574.00	2(0.4)	9,196	4,598.00
Total	1025(100)	3,324,698	3246.75	467(100)	2,566,046	5,448.08

The most likely body parts of older workers to be injured on construction sites were:

- Finger (17.8%);
- Trunk (17.1%); and
- Eye (9.4%),

while the most likely body parts of younger workers to be injured on construction sites were:

- Finger (21.1%);
- Eye (13.9%); and
- Trunk (13.0%).

The injuries representing the highest cost on average for older workers were ankle (R13,548.89) injuries followed by head injuries (R11,314.75) and multiple injuries (R9,242.50). For younger workers the representation was somewhat dissimilar. Multiple injuries (R10,250.80) represented the highest average cost followed by leg injuries (R5,741.29) and arm injuries (R4,829.91).

4.3.6 Taking indirect injury costs into account

The costs reflected in the tables above all depict the direct injury costs i.e. medical costs and lost work shifts. The third objective of the study is to investigate the direct and indirect costs carried by work related injuries and in particular identifying if older workers are more costly. It has already been ascertained that older worker injuries cost approximately 40% more on average compared with younger worker injuries. Hinze (2006) conducted an extensive investigation into the apparent indirect costs associated with 834 injuries reported by 100 construction firms in 34 states in the U.S. Indirect costs were then calculated based on detailed information received by investigators. The aim was to design an accurate model for calculating site indirect costs, being those indirect costs available within a reasonably short time after an injury. The investigation realised the site indirect costs for medical injuries at an additional 85c for every dollar spent. For lost work shift injuries the site indirect costs ended up being 23c for every dollar spent bearing in mind that the direct costs of lost work shift cases in themselves are considerably higher than mere medical injuries.

Considering that the average cost of a younger worker injury as determined by this study is R3,242.87, the site indirect costs would be an additional R2,756.44 bringing the total cost to R5,999.31 for medical injuries i.e. injured person visits a doctor but is not booked off work. In the case of a lost work shift injury (injured worker is booked off work for a full shift or more), the site indirect cost would be R3,988.73.

For older workers the scenario is as follows:

- Medical cases: R5,509.51 x 0.85 = R4,683.08 (site indirect costs)
  R5,509.51 + R4,683.08 = R10,192.59 (total injury cost)
- Lost work shift injuries: R5,509.51 x 0.23 = R1,267.19 (site indirect costs)
  R5,509.51 + R1,267.19 = R6,776.70 (total injury cost)

What needs to be understood from these scenarios is that medical case injuries due to their associated medical costs being substantially lower on average compared with lost work shift injuries result in the ratios between direct costs and site indirect costs being much higher. By applying this cost calculation method to a construction project example, the true costs of injuries may look something like this:

Multi-level apartment block to be built in 18 months and with a construction value of R200 million. During the project, 34 medical cases and 8 lost work shift injuries resulted (all contractors). Using Hinze's cost model, the true injury costs would be as follows:

Medical case injury costs:

34(direct + indirect) = …

34(R614 + R519) = R38,522

Lost work shift injury costs:

8(direct + indirect) = …

8(14,223 + R6,910) = R169,064

Total cost of project injuries = R207,586

Specific to this study, using the construction company sample, the total injury costs will take on the following appearance:

Younger workers (medical cases as an example):

152(R2,211 + R1,879) = R621,680

The cost without including indirect costs was R336,072

Older workers (medical cases as an example):

159(R2,689 + R2,286) = R790,969

The cost without including indirect costs was R427,551

Total injury cost to company for the year 2002 = R1,412,649.

The most accurate model identified by Hinze to calculate the site indirect costs for individual injuries is as follows:

- Site indirect costs (medical cases) = $150 + $15F + $30H + $100A
  F = the number of hours lost by injured worker to receive follow up care
  H = the number of hours lost by the injured worker on the day of the injury
  A = the number of hours spent by the administrative and supervisory personnel to assist the injured worker on the day of the injury
  Then, to calculate the total indirect costs, multiply them by 1.4.

- Site indirect costs (lost work shift cases) = $625 + $20F + $20H + $50V
  F = the number of hours lost by injured worker to receive follow up care
  H = the number of hours lost by the injured worker on the day of the injury
  V = the number of hours spent by administrative personnel to investigate the injury
  Then, to calculate the total indirect costs, multiply them by 9.

Example: A scaffold team leader falls from a scaffold while conducting alterations to it. He is not seriously injured however receives on-site first aid treatment and is taken to a doctor for medical treatment including x-rays. The doctor does not book him off and tells him he can return to work. The worker returns to work the following morning – 5 hours were lost due to the injury. The injured worker was also told to return for an intermediate follow up with the doctor and would then need a final 'close out' visit. The time spent on these visits was 3 hours per visit including travel as the doctor was relatively close to work. The medical case requires certain legal compliance paperwork to be completed in terms of workman's compensation and internal company protocols.

- Site indirect costs (medical cases) = R150 + R15F + R30H + R100A
  F = the number of hours lost by injured worker to receive follow up care (6 hrs)
  H = the number of hours lost by injured worker on the day of the injury (5 hrs)
  A = the number of hours spent by the administrative and supervisory personnel to assist the injured worker on the day of the injury (3 hrs)
  Then, to calculate the total indirect costs, multiply them by 1.4.

  [R150 + R15(6) + R30(5) + R100(3)] x 1.4 = site indirect costs
  [R690] x 1.4 = R966
  The direct costs were calculated at: R870 (doctor's consultations x 3) + R350 (x-rays) + medication dispensed (R220) = R1,440.
  Total cost of injury: R1,440 (direct) + R966 (site indirect) = R2,406.

  A similar example, but this time leading to the injured worker sustaining a fracture to his ankle will result in the following outcome:

  Example: A scaffold team leader falls from a scaffold while conducting alterations to it. He is seriously injured, diagnosed with a compound fracture of the left ankle. The worker undergoes surgery and remains in hospital for 48 hours. He is subsequently booked off work for sixty days. The injury was then investigated by the site safety officer, section foreman and site manager together with the group safety manager. The time spent on the investigation was conservatively estimated at 8 hours (2 hour x 4 site personnel) including report writing. The Department of Labour also visited site, as the injury was a 'reportable' case (a further 8 hours spent).

- Site indirect costs (lost work shift cases) = R625 + R20F + R20H + R50V

  F = the number of hours lost by injured worker to receive follow up care (20hrs)

  H = the number of hours lost by injured worker on the day of the injury (5 hrs)

  V = the number of hours spent by administrative personnel to investigate the injury (8 hrs +)

  Then, to calculate the total indirect costs, multiply them by 9.

  [R625 + R20(20) + R20(5) + R50(8 + 8)] x 9 = site indirect costs

  [R1,925] x 9 = R17,325

  The direct costs in this case were calculated at: R8,500 (doctor's consultations) + R2000 (x-rays and scans) + hospital and surgery (R15,000) + medication dispensed (R2,500) = R28,000.

  Total cost of injury: R28,000 (direct) + R17,325 (site indirect) = R45,325.

It should be quite clear from this analysis and interpretation of injury costs that the real costs of construction injuries is substantially higher than what's portrayed on the surface.

4.3.7 Summary of insurance company injury costs data

The injury claims sample collected from FEM (Federated Employer's Mutual Assurance Company), a registered workman's compensation insurance supplier to the construction industry indicated that 31.3% of claims reported were for older workers (> 40 years old) and 68.7% were younger worker injuries. Younger workers therefore constituted two thirds of the claims reported.

The total cost of injuries to younger workers was R3,323,941 and for older workers it was R2,572,941. It is however in the average cost per injury where the real difference lies. Younger worker injuries cost on average R3,242.87 compared with the older group where the average cost was R5,509.51. Of the 1025 younger worker injuries, 669 (65.3%) cost less than R1,000 while for older workers this number was 245 (52.5%). Older worker injuries cost on average R5,500 compared with the younger worker sample where the average cost was significantly less (R3,243), a difference of 41% on average.

The trades most injured in both cohorts were labourers (general workers) and carpenters. Plumbers represented the highest average injury cost for older workers while for younger workers, painters cost on average the most.

The events leading to the most injuries were the same for both younger and older workers being: struck by; strike against; and fall on different level. ‘Fall on different level’ represented the highest average cost per claim for both cohorts. There did not seem to be any conclusive evidence of any discernable difference between younger and older workers and the events leading to their injuries.

The types of injuries (nature of injury) responsible for the most injuries in both younger and older workers were ‘Superficial wounds’, ‘Penetrating wounds’ and ‘Muscle injury’. Bony injuries represented similar distribution between the two cohorts. Bony injuries amongst older workers represented a significantly higher average cost.

The body parts most affected due to injuries were similar for both groups: finger; trunk; and eye. The average costs of the injuries by body part differed for the two cohorts with ankle injuries representing the highest average cost while for younger workers, multiple injuries were on average the highest.

4.4 Analysis of construction worker interviews

This section serves to analyse the data ascertained from the construction worker survey vis a’ vis: demographic information; level of education; language proficiency; injury history and severity; medical interventions; and training information. Seventy survey instruments were administered by eight construction site safety & health practitioners (health & safety officers). Sixty were successfully completed and returned and manually analysed, representing a response rate of 87.5%. The respondents surveyed were split between younger workers (18) making up 30% of the sample, and older workers (42) making up the balance, 70%.

4.4.1 Demographical data

The age of each respondent was ascertained in years so that a clear distinction could be made between younger (<40 years old) and older workers (>40 years old) for the purpose of analysis.

The ages ranged between 20 years and 39 years for the younger workers sampled and between 40 years and 65 years for the older sample. The mean age for the younger group was 32.4 years while for the older group it was 51.7 years. The median age for the younger sample was 33 years while for the older sample it was 50 years.

4.4.1.1 Employment history

Table 22. Work history of respondents in years

Category	Younger (18)	Older (42)
In construction	7.8	20.9
For current employer	5.4	11.4
In other industries	3.6	7.2

Table 22 indicates that older workers had worked longer in all three categories namely in construction; for their current employer; and in other industries. The average length of employment in construction as reported by older workers was 20.9 years. The average period of employment of older workers with their current employer was reported to be 11.4 years while they had worked in other industries for 7.2 years on average.

4.4.1.2 Trade / occupation

Table 23. Employment category in construction

Trade	Younger (18)	Percent	Older (42)	Percent
General worker	5	27.8	15	35.7
Shutter hand	2	11.1	3	7.1
Carpenter	2	11.1	3	7.1
Bricklayer	1	5.6	4	9.5
Roofer	1	5.6	-	0
Plasterer	-	0	2	4.8
Painter	-	0	-	0
Other	7	38.9	15	35.7

The distribution of trades for both younger and older workers is shown in Figure 11.

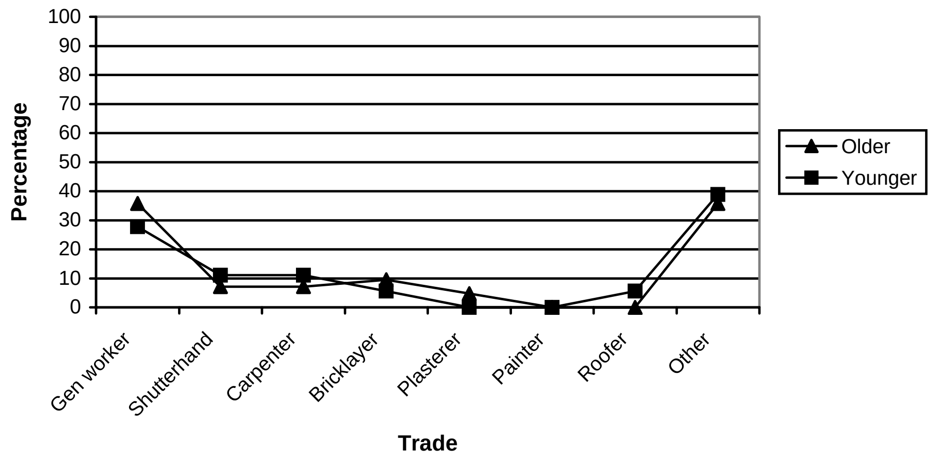


Figure 11. Employment capacity in construction (trades)

Table 23 indicates that most workers in the sample were general workers in both age categories. Most younger workers were in the category 'Other' (38.9%) which included such trades as electrician, concrete hand, store man, and operator. The next most frequent trade was ' General Worker' (27.8%). For older workers, the categories 'General Worker' and 'Other' were the most frequently distributed (35.7% each). It is worth noting that this high percentage of older workers still classified as general workers indicates that age and experience does not necessarily directly relate into skills and therefore does not guarantee promotion in the construction environment.

The mean age of the older worker general workers was 49.9 years with two general workers being 63 years old.

4.4.1.3 Level of education

Table 24. Level of education achieved

Education level	Younger (18)	Percent	Older (42)	Percent
0 (no formal education)	-	0	3	7.1
Sub A-Std 5 (grade 1-7)	2	11.1	14	33.3
Std 6-8 (grade 8-10)	5	27.8	17	40.5
Std 9-10 (grade 11-12)	8	44.4	6	14.3
Technical college	3	16.7	2	4.8
Other	-	0	-	0

Level of education achieved for both younger and older workers is represented in Figure 12.

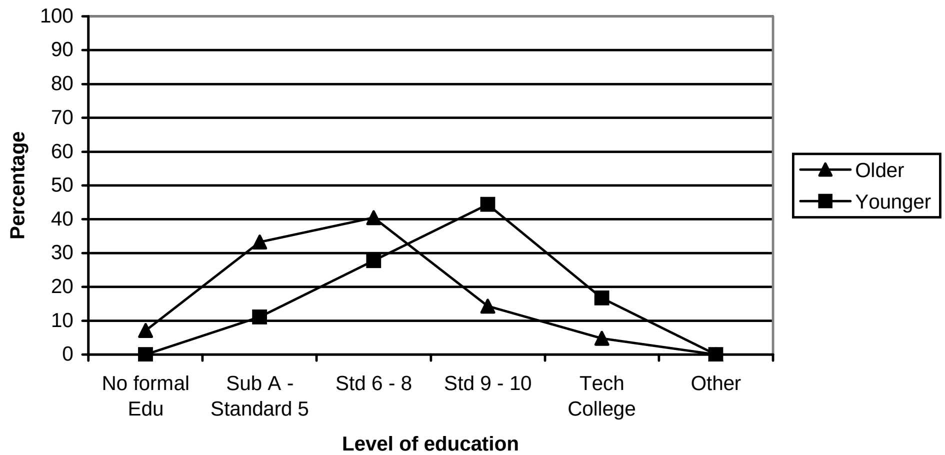


Figure 12. Level of education achieved

Table 24 indicates that the most significant difference between the levels of education of younger and older workers was that younger workers (61.1%) had either completed standard 9 or matric (grades eleven and twelve) or had been to technical college while for older workers this was only 19.2%. The majority of older workers had only completed standard six, seven or eight (grades eight, nine and ten). It must also be noted that 40.4% of older workers had not reached high school (sometimes termed secondary school). This finding supports the literature which concluded that the older the worker, the lower the level of literacy due to lower average levels of education in the past (Fuller, Liang and Hua, 1996).

4.4.1.4 Language literacy

Table 25. Home language

Language	Younger (18)	Percent	Older (42)	Percent
Afrikaans	9	50	14	33.3
Xhosa	7	38.9	26	61.9
English	-	0	1	2.4
Other	2	11.1	1	2.4

Home language (first language) as reported by the respondents is represented in Figure 13.

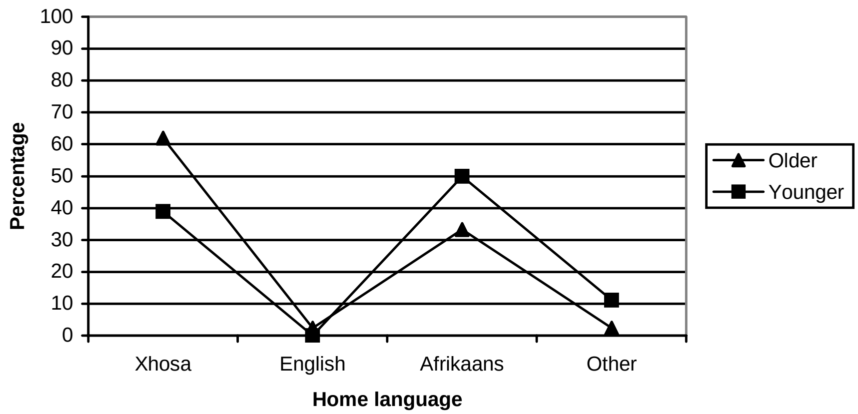


Figure 13. Home language (first language)

Table 25 illustrates that for both age cohorts Xhosa and Afrikaans dominated. Of the younger workers sampled, the largest percentage (50%) spoke Afrikaans as their first language. Xhosa was the second most frequent language spoken (38.9%). The older workers were predominantly Xhosa speaking with Afrikaans being the second most important first language spoken. It is worth noting that among both cohorts sampled, English was a first language in only one instant (1.7%).

Table 26. Literacy levels – home language

Cohort	Yes	No
Younger (18)	18	-
Older (42)	40	2

Table 26 indicates that only two older workers could not read and write in their first language (4.8%). Their ages were forty-eight and fifty-one years.

Table 27. Literacy levels – English proficiency

Cohort	Yes	No
Younger (18)	15	3
Older (42)	29	13

Table 27 shows that of the younger worker group, three workers (16.7%) were not proficient in English compared with the older group, which had a 31% English illiteracy rate, meaning that they could not read and write in English (Table 27). The workers not proficient in English (younger and older) were in 13 cases Xhosa speaking, in two cases Afrikaans and in one case Tsonga speaking (other).

4.4.2 Injuries

Table 28. Construction injuries sustained

Cohort	Yes	No
Younger (18)	12	6
Older (42)	33	9

For the purposes of this research, injuries included first aid injuries.
According to Table 28, 33.3% of younger workers indicated that they had not been injured on construction sites (Table 28). Slightly less than a quarter (21.4%) of older workers indicated that they had not been injured. A quarter (25%) of respondents had never been injured.

The respondents who had reported injuries were then asked to elaborate on the number of injuries sustained by them. This finding is shown in Table 29.

Table 29. Number of injuries sustained

Injuries	Younger (18)	Percent	Older (42)	Percent
1	4	33.3	7	21.2
2-5	7	58.3	20	60.6
6-10	-	0	5	15.2
>10	1	8.3	1	3.0
Total	12	100	33	100

The number of injuries sustained by each respondent as reported is represented in Figure 14.

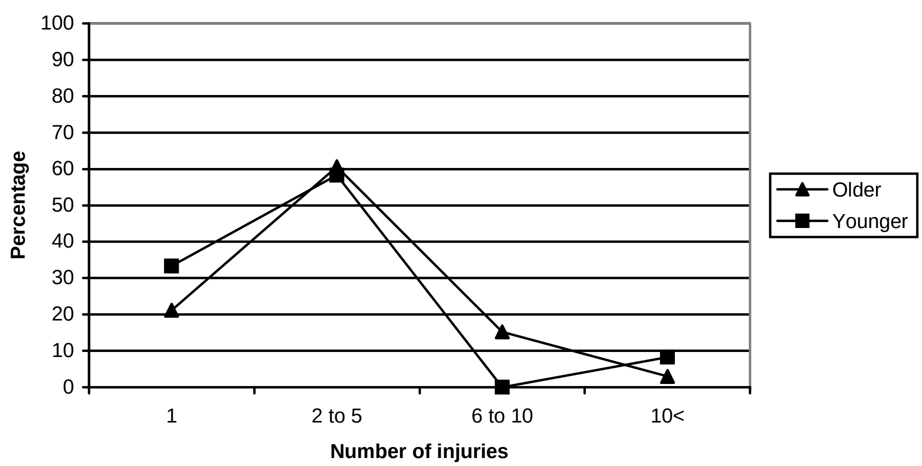


Figure 14. The number of injuries sustained by each worker

Table 21 illustrates that most younger (58.3%) and older (60.6%) workers had been injured between two and five times during their working careers. Workers indicating that they sustained only a single injury represented 24.4% of the total sample.

4.4.2.1 Types of injuries

Table 30. Types of injuries sustained

Type	Younger (18)	Percent	Older (42)	Percent
Superficial (burns, bruising, lacerations)	13 +15 (28)	49.1	33	58.9
Penetrating wounds (eyes, puncture wounds)	2 + 7 (9)	15.8	7	12.5
Multiple injury	0 + 7 (7)	12.3	-	0
Muscle injury (strains)	3 + 3 (6)	10.5	10	17.9
Bone injury (fracture)	3 + 2 (5)	8.8	1	1.8
Joint injury (sprains)	1 + 1 (2)	3.5	4	7.1
Amputation	-	0	1	1.8
Total	57	100	56	100

The types (nature) of injuries suffered by the respondents is represented in Figure 15.

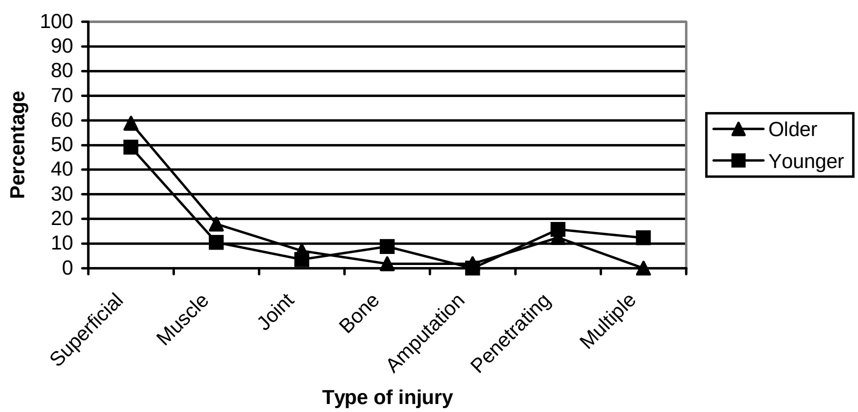


Figure 15. Types of injuries sustained

Of the 113 injuries reported by the 45 respondents who indicated that they indeed sustained injuries, 50.4% were under the age of 40 when they were injured while the balance, 49.6% were over the age of 40 (Table 30). The injuries were therefore equally distributed between the younger and older cohorts. From Table 30, it is evident that superficial wounds such as burns, contusions and lacerations were the most common types of injuries in both the younger and older workers, 49.1% and

58.9% respectively. Multiple injuries (12.3%) were the second most frequent type of injury for the younger group while muscle strains (17.9%) were the second most common type of injury amongst the older worker group. Penetrating wounds were equally common in both groups, 15.8% and 12.5%. It is significant to note that bony injuries such as fractures were more common amongst younger workers and not older workers, contrary to the literature. According to Hinze (2005), older workers were more prone to bony related injuries due to their bones being more brittle.

4.4.2.2 Events leading to injuries

Table 31. Events leading to injuries

Event	Younger (18)	Percent	Older (42)	Percent
Caught in/on/between	12	26.1	14	29.2
Struck by object	8	17.4	13	27.1
Accident N.E.C	7	15.2	-	0
Fall onto different level	6	13.0	2	4.2
Striking against an object	5	10.9	11	22.9
Fall onto same level	5	10.9	5	10.4
Overexertion	3	6.5	3	6.3
Contact with extreme temp.	-	0	-	0
Contact with electricity	-	0	-	0
Total	46	100	48	100

The events (causes) leading to the injuries as reported by the respondents is represented in Figure 16.

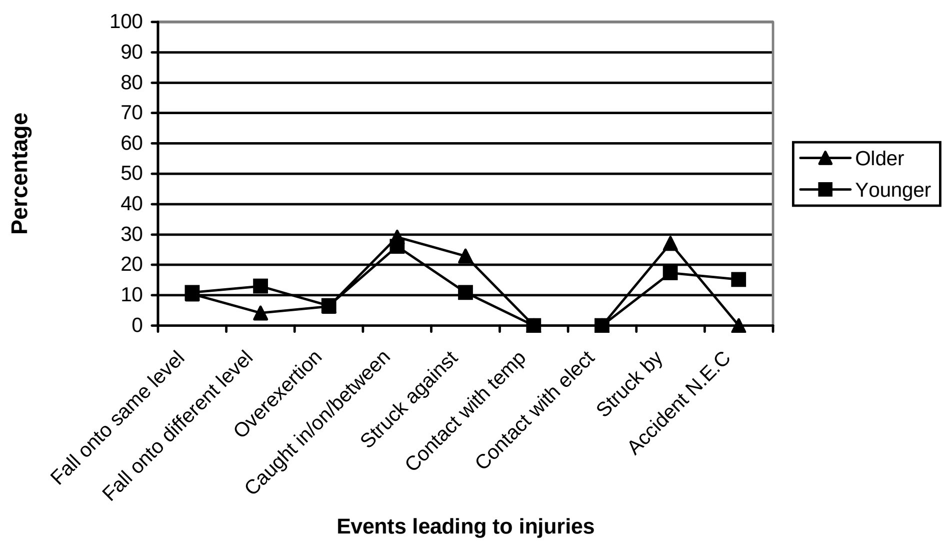


Figure 16. Events leading to injuries

According to older workers, the events leading to their most injuries were:

- Caught in/on/between (29.2%);
- Struck by object (27.1%); and
- Striking against an object (22.9%),

while the most likely events leading to injuries amongst younger workers were:

- Caught in/on/between (26.1%);
- Struck by object (17.4%); and
- Accident N.E.C (15.2%).

It is worth noting that 'Falls onto different levels' was more prevalent amongst younger workers (13.0%) compared with older workers (4.2%).

4.4.2.3 Body parts affected

The body parts affected as a result of the injuries sustained by the respondents is represented in Figure 17.

Table 32. Body parts affected

Body Part	Younger (18)	Percent	Older (42)	Percent
Hand (incl. wrist)	11	21.6	18	34.6
Finger	10	19.6	6	11.5
Leg	6	11.8	8	15.4
Arm	6	11.8	3	5.8
Trunk (torso, ribs, back)	5	9.8	4	7.7
Eye	4	7.8	1	1.9
Foot	3	5.9	4	7.7
Shoulder	2	3.9	1	1.9
Head (exclude eyes & ears)	2	3.9	-	0
Ankle	1	2.0	3	5.8
Neck	1	2.0	-	0
Knee	-	0	3	5.8
Multiple	-	0	-	0
Other	-	0	1	1.9
Total	51	100	52	100

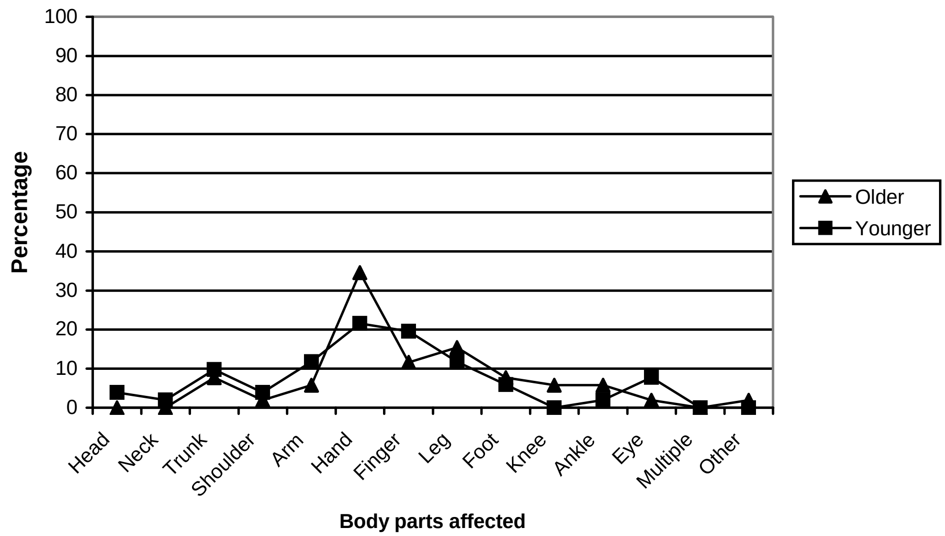


Figure 17. Body parts affected

According to older workers, the body parts most affected due to the injuries sustained by them were:

- Hand (incl. wrist) (34.6%);
- Leg (15.4%); and
- Finger (22.9%),

while the most likely body parts injured amongst younger workers were:

- Hand (incl. wrist) (21.6%);
- Finger (19.6%); and
- Arm, and leg (both11.8%).

It is worth noting that older workers suffered considerably more knee (5.8% compared with 0%) and ankle (5.8% compared with 2.0%) injuries while eye injuries were more prevalent amongst younger workers (7.8% compared with 1.9%).

4.4.2.4 Injury severity

Table 33. Severity of injuries and days off work

Category	Younger (18)	Days off work (ave)	Older (42)	Days off work (ave)
Disabling injury (off work for one full shift or more)	12 (50%)	180 (15.0)	9 (34.6%)	518 (57.6)
Medical case (doctor, but not off work)	6 (25%)	-	12 (46.2%)	-
First aid only	6 (25%)	-	5 (19.2%)	-
Occupational condition / disease	0 (0%)	-	0 (0%)	-
Total	24 (100%)	180 (15.0)	26 (100%)	518 (57.6)

The distribution of injury categories for the construction worker sample is shown in Figure 18

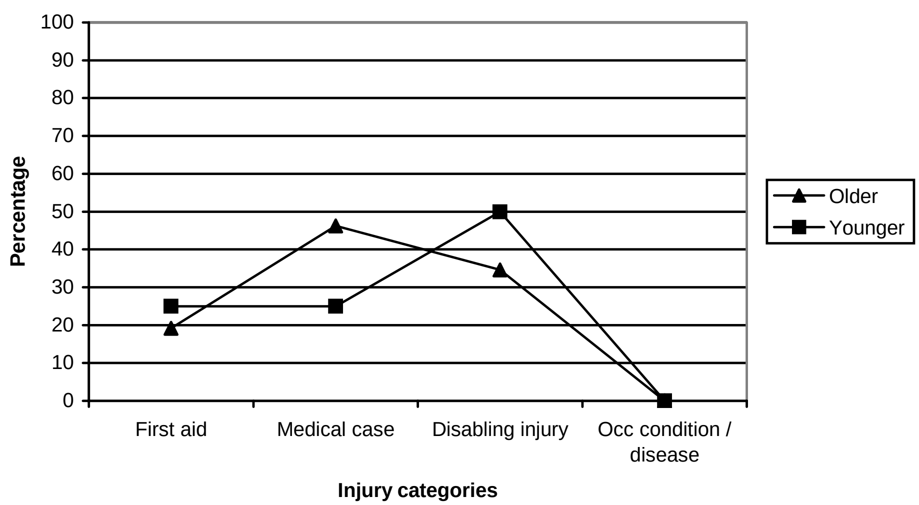


Figure 18. Injuries sustained per category (Construction worker sample)

Of the 26 older worker responses, it was evident that they sustained less serious injuries (34.6%) when compared with their younger counterparts who reported more instances of disabling injuries (50%). It was however the older workers whose injuries (9) resulted in more lost work shifts on average (57.6%) compared with the younger respondents, 15 shifts lost on average. Older workers also reported that they visited the doctor more frequently (46.2%) as a result of their injuries compared with younger workers (25%).

4.4.3 Management interventions

4.4.3.1 Occupational health interventions

Table 34. Occupational health interventions

OH Intervention	Younger (18)	Percent	Older (42)	Percent
Working at heights evaluation	10	43.5	28	38.4
Not exposed to any of the above	6	26.1	7	9.6
Pre-employment medical	4	17.4	19	26.0
Intermediate medical (during employ.)	3	13.0	15	20.5
Post-employment medical	0	-	4	5.5
Total	23	100	73	100

The occupational health interventions experienced by the respondents is represented in Figure 19.

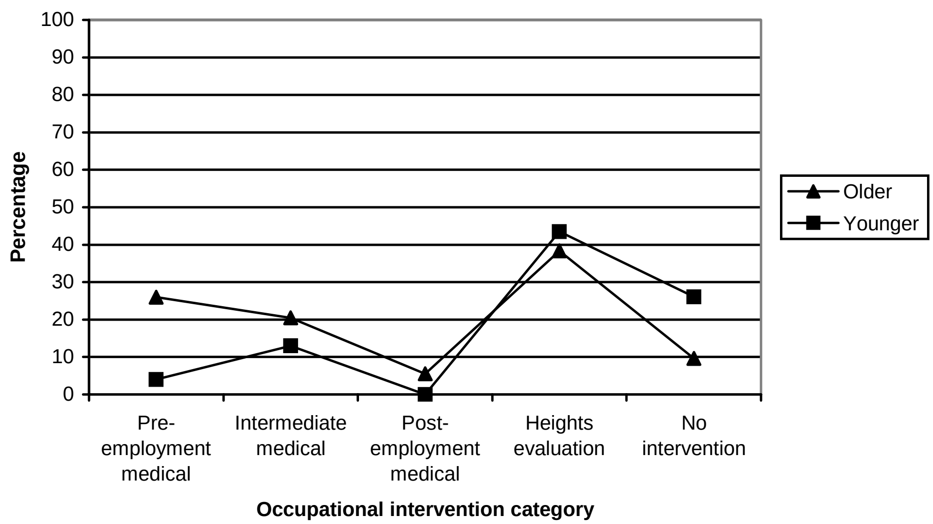


Figure 19. Occupational health interventions experienced

Table 34 indicates that both the older (38.4%) and younger (43.5%) respondents noted that they had mostly been exposed to occupational health interventions involving fitness evaluations for working in elevated positions/work locations. Pre-employment medicals were significantly more common amongst older workers (26.0% compared with 4.0%). Another significant finding was that 26.1% of the younger worker respondents reported that they had not been exposed to any of the occupational health interventions listed in the questionnaire interview.

4.4.3.2 Training interventions

Table 35. Training received

Training	Younger (18)	Percent	Older (42)	Percent
Induction training (site)	17	22.7	37	23.3
Toolbox talk training (informal)	17	22.7	35	22.0
Training on the use of tools and machines	14	18.7	22	13.8
Skill-specific training (trade specific)	11	14.7	25	15.7
Fall prevention training	9	12.0	24	15.1
H&S training (class room)	7	9.3	15	9.4
None of the above	0	-	1	0.6
Total	75	100	159	100

The training interventions experienced by the respondents is represented in Figure 20.

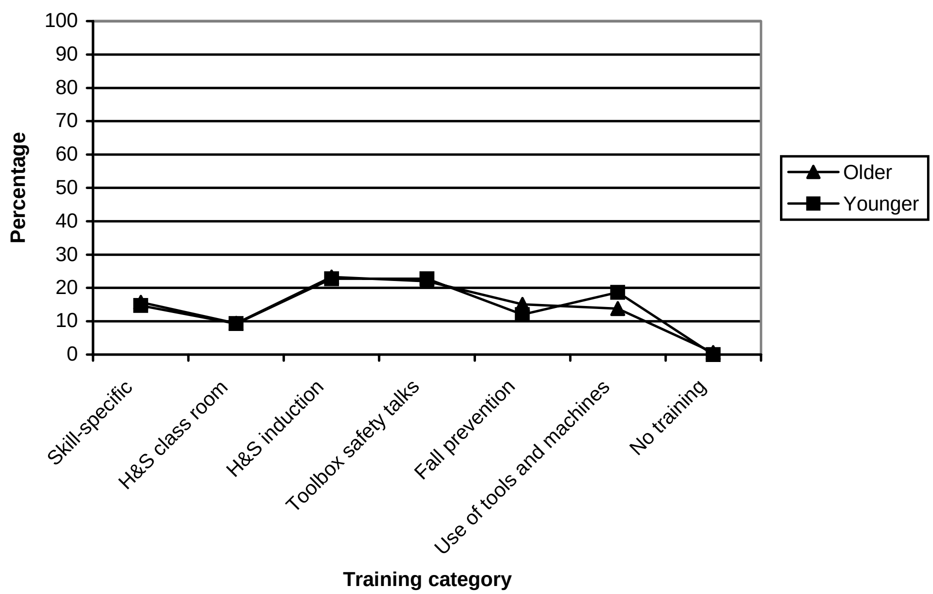


Figure 20. Training interventions experienced

Table 35 illustrates that of the 18 younger worker respondents, 17 had undergone induction training and toolbox talk training. Similarly among the older respondents, induction training and toolbox safety talks had been attended by 37 and 35 of the 42 respondents respectively.

Table 36. Training - is it an effective means of lowering injury risk

Cohort	Yes	No
Younger (18)	17	-
Older (42)	36	4

Younger workers were unanimous in their responses and agreed that training would help to lower the chance of them getting injured (Table 36). Older workers (85.7%) agreed that training would be beneficial and would reduce the chance of being injured. Of the 60 respondents, three did not answer the question.

The respondents who agreed that training reduces the risk of injury were then asked to elaborate on what training in particular would be most beneficial and what would be least beneficial to them.

Table 37. Training – most beneficial

Training	Younger (18)	Percent	Older (42)	Percent
Skills training (trade)	6	37.5	12	41.4
H&S training (class room)	4	25.0	2	6.9
Induction training	4	25.0	3	10.3
Toolbox talk training	1	6.3	5	17.2
Training on the use of tools and machines	1	6.3	6	20.7
Fall prevention training	-	0	1	3.4
Total	16	100	29	100

The training reported as being most beneficial by the respondents is represented in Figure 21.

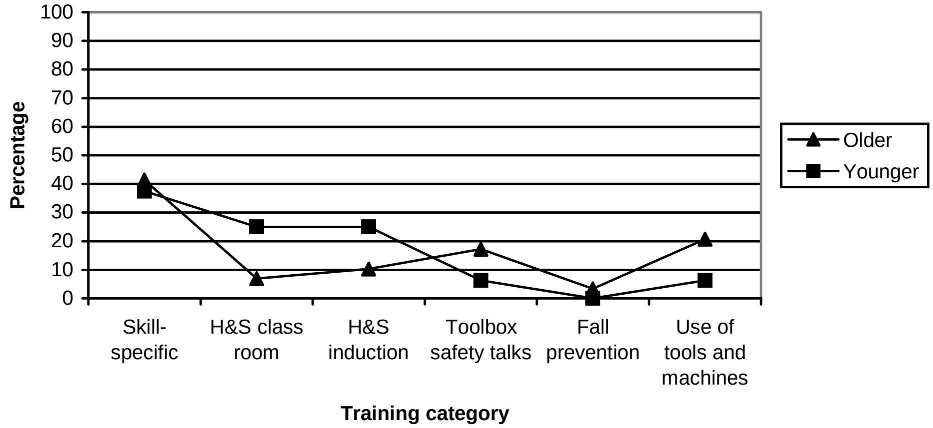


Figure 21. Training category reported as most beneficial

Table 37 indicates that the younger respondents (37.5%) felt that skills training would be the most beneficial in an effort to reduce the chance of injury, closely followed by formal health & safety (H&S) classroom training (25.0%) and safety induction training (25.0%). The older workers responded that they thought skills training (41.4%) would also be the most beneficial to them followed by training on the use of tools and machines (20.7%) and toolbox safety awareness training (17.2%) which was deemed to be significantly more beneficial in terms of the older respondents – only one younger worker thought that toolbox talks held any benefit in an effort to reduce injuries on construction sites. It is worth noting that both amongst the older and younger samples, fall prevention training was not seen to be beneficial as an injury reduction training strategy. Please note that of the sixty questionnaires completed in total, 19 respondents did not complete this question satisfactorily (Table 37 and 38) – either partially completed, or left out altogether.

Table 38. Training – least beneficial

Training	Younger (18)	Percent	Older (42)	Percent
H&S training (class room)	6	46.2	14	50.0
Induction training	5	38.5	-	0
Training on the use of tools and machines	1	7.7	7	25.0
Toolbox talk training	1	7.7	5	17.9
Fall prevention training	-	0	2	7.1
Skill training (trade)	-	0	-	0
Total	13	100	28	100

The training reported as being least beneficial by the respondents is represented in Figure 22.

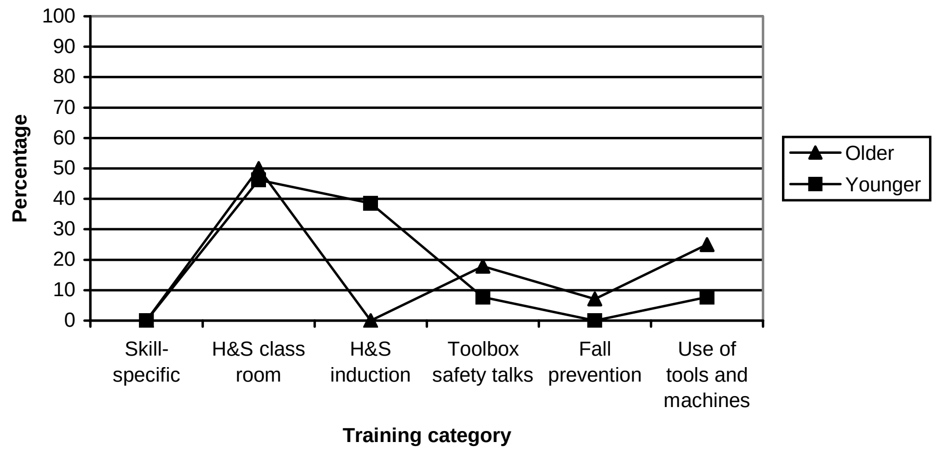


Figure 22. Training category reported as least beneficial

Table 38 illustrates that the type of training seen as being the least beneficial by the younger workers was classroom health & safety training (46.2%) followed by induction training (38.5%). Older workers felt that classroom health & safety training (50.0%) followed by training on the use of tools and machines (25.0%) were the least beneficial as an injury reduction training strategy.

Table 39. Training – refused

Cohort	Yes	No
Younger (18)	1	17
Older (42)	13	27

The younger workers with the exception of one respondent had never been refused training (Table 39). Just less than a third (31%) of the older workers reported that they had been refused training at some time in their construction career. This finding is supported in the literature, which concluded that older workers received less training (Patrickson and Hartmann, 1995).

Those respondents who had asked for training and been refused were asked to elaborate on whether they thought their age was an influencing factor, preventing them from getting the necessary access to training. In other words did they think they were too old and therefore were refused training opportunities?

Table 40. Training - perception of influence of age

Cohort	Yes	No	Unsure
Younger (18)	-	1	-
Older (42)	5	4	4

The younger worker who responded that he had been refused training in the past, felt that this was not due to his age (Table 40). Of the 13 older workers who were declined training in the past, 5 (38.5%) felt that their age was a determining factor and a further 4 (30.8%) were unsure.

Table 41. Training – level of understanding (literacy)

Cohort	Yes	No	Unsure
Younger (18)	15	-	-
Older (42)	36	-	1

The finding here was somewhat surprising in that all respondents with the exception of one reported that they understood the training they received (Table 41). This is in contrast to a previous finding of this research, which reported that older workers have a 31% English literacy level and younger workers 16.7%. Historically and up to very recently all training has been conducted in English or Afrikaans.

4.4.4 Summary of construction worker interviews

The construction worker survey conducted found as expected that the older workers sampled had been employed in construction as well as for their current employer on average for longer. The trade ‘General worker’ was the most representative amongst both younger and older respondents. The older respondents indicated that they had a significantly lower level of education on average together with an associated lower level of English literacy.

The respondents (younger and older) indicated that the injury category representing the highest average lost time was ‘2-5 days lost per injury’. The injuries reported by the respondents were equally distributed between younger and older. The types of injuries were also similar for both groups. Bony injuries were more common amongst the younger respondents. The events leading to injuries amongst the respondents were evenly distributed with the exception of ‘Fall onto different level’ which was significantly higher for the younger respondents. Hand injuries were reported by both the younger and older workers to be the most frequent body part affected. The younger workers interviewed reported that they had sustained more severe injuries on average compared with the older respondents but that their injuries resulted in less work shifts lost.

Management interventions surveyed included medical and training interventions. Medical evaluations involving fitness to work at heights was the most frequent intervention experienced by both the older and younger respondents. The training category reported to be the most common by both respondent groups was induction and toolbox talks. The most beneficial training was perceived to be skills training (trade-specific) as reported by both groups. The least beneficial was perceived to be class room (formal) health & safety training, also reported by both groups. Older worker reported in 31% of the responses that they had in fact been refused training at some time in the past compared with a single (5.6%) younger work response to this effect. The surveys indicated that older workers in 38.5% of the responses felt that age was a reason for them not receiving training. With the exception of one respondent, level of understanding of the training undertaken was not reported to be a problem.

4.5 Analysis of construction manager questionnaires

This section serves to identify the perceptions of older construction workers by construction site managers vis a' vis: productivity; injury rates; present company policies; importance to the industry as well as what interventions could improve the management of older workers. Twenty-eight questionnaires were distributed to construction site managers of ten different construction companies. Eighteen questionnaires were completed and returned and manually analysed, representing a response rate of 64.3%. The results were as follows.

Table 42. Perceived age of older workers

>30 yrs	>40 yrs	>50 yrs
-	1 (5.6%)	17 (94.4%)

Table 42 indicates that all the respondents with the exception of one perceived older construction workers were over the age of 50 years. Respondents were not asked to comment on any other criteria such as length of employment when determining whether a worker is older or younger. From Table 42, it is clear that 94.4% of managers surveyed perceived older workers to be over the age of 40 years.

4.5.1 Productivity levels

Table 43. Perception of older worker productivity rates

Younger	Older	Both	Unsure
4 (22.2%)	3 (16.7%)	10 (55.6%)	1 (5.6%)

Table 43 illustrates that the majority (55.6%) of respondents believed that both cohorts were equally productive. The split between whether older or younger workers were more productive was almost equally distributed. One respondent was ‘unsure’.

4.5.2 Injuries

Table 44. Perception of older worker injury rates

Younger	Older	Both	Unsure
7 (38.9%)	3 (16.7%)	6 (33.3%)	2 (11.1%)

The majority (38.9%) of respondents believed that younger workers were more prone to injuries (Table 44). A further 33.3% were of the opinion that both older and younger were equally prone to injuries. Only 3 respondents (16.7%) thought that older workers were more prone to work related injuries. Two respondents were ‘unsure’.

Table 45. Perception of the severity of older worker injuries

Younger	Older	Both	Unsure
8 (44.4%)	3 (16.7%)	6 (33.3%)	1 (5.6%)

This question was included with the aim of ascertaining whether there was any difference in managers’ perceptions between mere injury exposure of older and younger workers compared with the severity of their injuries. Table 45 illustrates that the responses were almost identical to the responses in table 44, being mere injury exposure. The majority of respondents (44.4%) believed that younger workers were more prone to serious injuries, although not overwhelmingly conclusive bearing in mind that 6 respondents were of the opinion that both groups were equally prone to serious injuries.

4.5.3 Injury costs

Table 46. Perception of whether injury cost are higher for older workers

Younger	Older	Both	Unsure
7	5	3	3

The results to this question were fairly evenly distributed between the four categories with seven respondents believing that younger workers were indeed responsible for higher injury related costs as summarised in Table 46. This finding is not supported the literature, which tended to find the older worker group in fact bearing higher injury costs on average (Hinze, 2005; Stalnaker, 1998; Zwerling and Sprince, 1996).

Table 47. Perception of the cost of older worker injuries

Cost category	Responses (%)
R1-1000	-
R1001-3000	7 (38.9%)
R3001-5000	6 (33.3%)
R5001-10000	4 (22.2%)
R10000<	1 (5.6%)

This question merely served to ascertain the perception of construction site managers with respect to what the average cost of a construction injury is, with the responses summarised in Table 47. Most respondents (38.9%) were of the opinion that injuries cost between R1,001 and R3,000 on average followed closely by 6 respondents who believed that injuries were more expensive costing between R3,001 and R5,000 on average. Four respondents (22.2%) thought that construction injuries cost between R5,001 and R10,000. FEM calculated the average cost of a construction injury to be R10,225 in 2006 indicating that the perception of one respondent was correct.

4.5.4 Company policies

Table 48. What older worker company policies are currently being implemented

Yes	No	Unsure
2 (11.1%)	16 (88.9%)	-

Table 48 indicates that 16 of the 18 respondents answered that they were not aware of any company specific management policies aimed at older workers. Those who responded affirmatively (11.1%) made reference to annual medicals, training, and HIV and AIDS being interventions which are in fact not age specific interventions as they are offered to all workers. From Table 49 it can thus be concluded that none of the construction companies participating in the survey had older worker-specific strategies or policies aimed at improving the management of this group.

4.5.5 Training

Table 49. Comparison of training received

Younger	Older	Both	Unsure
13 (72.2%)	-	4 (22.2%)	1 (5.6%)

Table 49 indicates that the majority of respondents agreed that younger workers were exposed to more training opportunities. Four respondents believed that both younger and older workers received the same training opportunities. Interestingly no respondents thought that older workers were exposed to more training. This finding is supported by previous research (Patrickson and Hartmann, 1995), which purports that older workers are exposed to less training opportunities namely safety and health related training; current job/trade up-skilling; and training for potential promotion.

4.5.6 Medical programs

Table 50. Medical programs currently being implemented

Yes	No	Unsure
16 (88.9%)	1 (5.6%)	1 (5.6%)

It is evident from those respondents who responded affirmatively that medical programs were being implemented by all the companies with the exception of one (Table 50). These respondents were asked to elaborate on the medical programs currently being implemented by their organisations.

Table 51. Types of medical programs currently being implemented

Program	Yes	No
Working at heights	11 (61.1%)	-
HIV and AIDS	11 (61.1%)	-
Intermediate (annual)	10 (55.6%)	-
Pre-employment	5 (27.8%)	-
Post-employment (exit)	1 (5.6%)	-
Other	2 (11.1%)	-

The medical programs most prevalent involved HIV and AIDS, working at heights evaluations and annual medicals offered to workers (Table 51). A significant finding is that pre-employment and post-employment medicals are only seen to be policies adopted by a minority of companies in question. In particular, only 1 respondent answered that exit medicals are a policy at their company. Of particular importance though is that annual medicals are only offered in ten of the 18 cases, an equivalent of 55.6%. Another important finding is that working at height assessments are not prevalent amongst more companies – only 11 respondents reported that they were aware of such company interventions/programs, an equivalent of 61%. The assessment of construction worker fitness to work in elevated positions became a legal requirement in South Africa in 2003 with the advent of the Construction Regulations.

The 2 respondents answering ‘other’ were aware of medical programs offered by their companies involving Tuberculosis.

4.5.7 The value of older workers to the construction industry

Respondents were asked on a 5-point scale of agreement where 1=strongly disagree, 2=disagree, 3=neutral, 4=agree, and 5=strongly agree, to respond to four statements, namely:

1. Older workers are valuable to the construction industry;
2. Older workers are more valuable than younger workers;
3. Older workers add limited value to the construction industry; and
4. Older workers tend to work safer than younger workers.

Table 52 sets out the analysis of construction manager responses to the four statements

Table 52. The value of older workers to the construction industry

Statement	1	2	3	4	5	M	SD	R
Older workers are valuable to the construction industry	- (0%)	- (0%)	- (0%)	9 (50%)	9 (50%)	4,50	0,51	1
Older workers tend to work safer than younger workers	- (0%)	2 (11.1%)	6 (33.3%)	8 (44.4%)	2 (11.1%)	3,56	0,86	2
Older workers are more valuable than younger workers	- (0%)	2 (11.1%)	11 (61.1%)	4 (22.2%)	1 (5.6%)	3,22	0,73	3
Older workers add limited value to the construction industry	4 (22.2%)	10 (55.6%)	2 (11.1%)	1 (5.6%)	1 (5.6%)	2,17	1,04	4

All respondents either agreed or strongly agreed that older workers were valuable to the industry. Of the four statements, this statement was the most strongly supported and received the highest rating with a mean of 4.50. Respondents tended to agree that older workers worked safer than younger workers with a mean of 3.50. Respondents were mostly neutral on the statement that older workers are more valuable than younger workers with a mean score of 3.22 recorded. The fourth statement, older workers add limited value to the construction industry, received a mean score of 2.17 and was therefore not supported.

4.5.8 Older worker interventions

Table 53. Support of older worker programs

Yes	No	Unsure
15 (88.2%)	2 (11.1%)	-

It must be noted that one respondent failed to answer the question hence the seventeen responses. The responses indicated that older worker programs would be well supported with the exception of 2 respondents who answered in the negative. Where ‘Yes’ was answered, respondents were asked to elaborate further by selecting one or more of the programs listed below including ‘other’ as a category.

Table 54. Older worker programs potentially supported

Program	Yes	No	Unsure
Regular interviews / assessments	10 (55.6)		1
Increased training (safety/job)	10 (55.6%)	4	
Regular medicals	10 (55.6%)	1	1
Redeployment to other tasks / occupations	8 (44.4%)	3	
Older worker forums / committees	4 (22.2%)	3	1
Other	3 (16.7%)		

The column 'No' was made available with the intention that respondents would either complete a 'Yes' or 'No' for each program category available. This however was not followed by all the respondents hence the disparities between the two columns. It can however be deduced from the findings that regular interviews/assessments, regular medicals and increased training (safety/job) would receive the strongest support, with redeployment to other tasks/occupations interestingly also receiving popular support among the respondents. Those answering 'Other' were asked to elaborate. The response in all three cases was that older workers should be utilised in programs aimed at mentoring younger workers in "construction skills, safety and productivity", "mentoring younger staff, training and showing the younger staff the correct way of doing work", "education of younger workers by older workers". This response was somewhat unexpected and slightly out of context seeing that the researcher was aiming to gather responses aimed at developing and protecting older workers. It does however make sense and puts an alternative slant on what 'older worker programs' could be translated as. The concept of utilising workers between the ages of 55 and 60 as mentors in the construction industry has been evident for quite some time now and may come to the fore considering that the 'skills shortage' seems to be further increasing. Some exponents of this concept suggest that it may even become necessary to retain workers with certain skills after retirement age in an effort to engage them in mentorship programs.

Table 55. Pensionable age supported

Pensionable age	Yes	No	Unsure
=60	9		
60<	7		
<60	1		1

During analysis it became clear that the 'Unsure' selection was not necessary and should therefore be discarded. The responses supported the notion that pensionable age should either remain at 60 years (50%) or could be increased (38.9%). Only 1 respondent was of the opinion that pensionable age should be decreased to somewhere below 60 years.

4.5.9 Summary of construction manager data

Construction managers perceived older workers to be over the age of 50 years and not 40 years as defined in the research. There was no discernable difference noted when it came to the perception of whether older workers were more or less productive.

Younger workers were reported to be more prone to injuries and were also perceived to be prone to injuries of a more severe nature. When asked about injury costs, site managers responded with an even distribution, the perception being that younger workers were responsible for slightly higher injury costs. Most respondents were of the opinion that injuries cost between R1,001 and R3,000. The vast majority of site managers were not aware of any company policies or interventions aimed specifically at older workers. Younger workers were exposed to more training opportunities. The findings clearly indicated that construction companies were implementing medical programs with 'working at heights evaluations', HIV and AIDS' and 'annual medicals' being the most commonly practised. Site managers agreed with the notion that older workers were more valuable to the industry compared with younger workers and similarly agreed that older workers were safer workers.

The majority of respondents were in favour of the implementation of older worker-specific management programs with the aim of maximising their potential. Increased training, regular medicals as well as regular interviews or assessments were cited as being the preferred programs. The final question posed to site managers related to pensionable age. Site managers were of the opinion the current age of 60 years was acceptable however 38.9% thought that it could be increased.

4.6 Chapter summary

The chapter served to analyse four separate sets of data with the aim of addressing the research objectives. A sample of injury data was obtained from a large construction company for the period 1998 through 2005 representing 525 injuries. The injury data was analysed to ascertain differences between the older and younger workers. Injury claims data was also sourced from FEM (Federated Employer's Mutual Assurance Company) for the period 2002 representing 1492 injury claims with the aim of analysing injury costs and identifying differences between older and younger claimants. A sample of sixty construction workers was interviewed to obtain descriptive data relevant to the study. Finally, data was collected from twenty-eight construction site managers by means of questionnaires. The perceptions of these managers in relation to older workers was then analysed.

The chapter was set out in the following order to facilitate the analysis process and to clearly represent the four separate sets of findings: Introduction; injuries to older construction workers; costs of injuries to older construction workers; analysis of construction worker interviews; analysis of construction manager questionnaires; chapter summary. Each of these sub-sections was also followed by a sub-section summary.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

Older construction workers are a valuable source of experience and skills and are exposed to a wide range of hazards leading to injuries that cost the industry millions of rands every year. In order to investigate this problem, a set of objectives was designed which formed the basis of the study. The study objectives were based on five hypotheses which required empirical testing. A number of conclusions were drawn and recommendations for future study formulated.

Relevant literature on the subject area was reviewed to form the contextual framework of the study. Data was gathered from four independent research populations to ascertain injury information and costs of injuries. The research instruments included: analysis of construction worker injury statistics of a large construction company operating in the Western Cape region of South Africa for the period 1998 through 2005; analysis of construction worker injury claims statistics including injury costs as recorded by a workman's compensation insurance company (FEM) with an office in the Western Cape region for the period 2002; questionnaire based interviews with sixty construction workers active on construction sites in the Cape Town area; and questionnaires sent to construction site managers to ascertain their perceptions of older workers.

The chapter draws conclusions from the findings and makes certain recommendations with respect to the study. The study realised some limitations which will be discussed. Recommendations for future research are also proposed.

5.2 Objectives of the study

The purpose of the study was to investigate the specific issues that affect the health & safety of older workers. It was suspected that certain injuries could be specific to older workers. The costs of these ‘older worker’ injuries could also be higher than for younger workers and therefore required investigation to ensure sustainable development in the construction industry. The study sought to achieve four primary objectives, namely:

- To determine what construction work related injuries are most common among older workers in terms of in particular; the trades most affected, the events leading to the injuries, the nature of the injuries, and the body parts affected.
- To examine the relationship between the severity of the injuries sustained by construction workers and their age to establish what tasks should be avoided.
- To establish the relationship between injuries to older workers and their consequent direct and indirect costs with the aim of convincing Employers that improved worker protection programs should be implemented to reduce injury costs.
- To investigate the relationship between lower literacy levels, education and the likelihood and severity of injuries sustained by older construction workers so that improved target related safety and health training may be implemented.

5.3 Hypotheses testing

5.3.1 H1. The prevalence of work related injuries is higher among older construction workers compared with younger workers.

The study found that total injuries were lower for older workers compared with younger workers. This was true for both the construction company sample and the workman’s compensation insurance sample. Construction workers reported an equal distribution of injuries between the younger and older respondents. Only 16.7% of construction site managers perceived older workers to be more prone to injuries. Therefore the hypothesis that work related injuries are higher among older workers may be rejected.

5.3.2 H2. Certain injuries are more likely to occur to older workers.

It was found that no discernable variances occurred between younger and older workers when it came to the events leading to injuries and the type/nature of injuries. It was, however, found that for the body parts affected older workers were more prone to back-related injuries and knee injuries. This was confirmed by the findings of the construction company sample, the FEM claims sample and the construction work interviews. The hypothesis that certain injuries are more likely to occur to older workers can therefore not be rejected.

5.3.3 H3. Injuries sustained by older construction workers are of a more serious nature compared with younger workers.

To determine the severity of an injury, the most common parameters used are 'lost shifts', whether a worker had to visit a doctor due to the injury sustained, and cost. The study found that among the construction company sample, older workers sustained less severe injuries and were off work for fewer work shifts compared to younger workers. The construction worker interviews found that older workers were prone to less severe injuries but that on average they lost more work shifts per injury. Older workers also reported that they visited a doctor more frequently as a result of their injuries compared with younger workers. Construction managers were of the opinion that older workers were less prone to severe injuries. The costs of injuries as reported by FEM showed that older worker injuries on average cost R5,500 compared with younger workers whose average cost per claim was R3,243. A difference of 41% on average indicating that older worker injuries were more severe using cost as an indicator. The hypothesis that older workers sustain more serious injuries compared with younger workers can neither be accepted nor rejected.

5.3.4 H4. The cost of injuries is higher among older construction workers.

The construction company sample as well as the FEM claims sample indicated that older worker injuries cost more on average compared to younger workers. In the FEM data, the difference was substantial, 41% in favour of the older workers. The hypothesis that injuries to older construction workers are more costly cannot be rejected.

5.3.5 H5. Older construction workers receive less training compared with their younger counterparts.

Of the older construction workers interviewed, 31% responded that they had been refused training in the past. Only one of the younger respondents stated that he had been refused training before. Construction managers were of the opinion that younger workers were exposed to more training opportunities. No managers supported the notion that older workers had access to more training opportunities than younger workers. The hypothesis that older workers receive less training than younger workers can therefore not be rejected.

5.4 Conclusions

5.4.1 The prevalence of work related injuries is higher among older construction workers compared with younger workers

The analysis of the injury database of a construction company as well as the claims reported to a workman's compensation insurer found that injuries to older workers were in fact less frequent. The construction company sample comprised 525 injuries of which 240 were older worker injuries and 285 being younger workers, a 45.7% - 54.3% split. The workman's compensation insurer claims sample comprised 1492 injury claims of which 467 (31.3%) were for older workers and 1025 (68.7%) were younger worker injuries. Of the construction workers interviewed it was found that there was an even split between younger and older worker injury prevalence rates. Those injured when under the age of forty was 50.4% while those sustaining their injuries when over the age of forty was 49.6%. The injuries were therefore equally distributed between the two cohorts. Construction managers were of the opinion that older workers were injured less than their younger counterparts and were therefore posed less of a risk. It can therefore be concluded that older workers are less prone to injuries when compared with their younger counterparts.

5.4.2 Certain injuries are more likely to occur to older workers

To address this statement a detailed investigation of: events leading to injuries (also termed causes of injuries); nature (type) of injuries; and body parts affected, was required with the aim of making the necessary comparisons between younger and older workers. The various trades or occupation categories were also taken into account to identify if in fact any particular trade differences were prevalent. Unskilled workers also termed labourers or general workers sustained the most injuries (61.1%) amongst the younger group of the construction company sample compared with the older worker group where skilled workers sustained the most injuries (39.2%). Skilled workers included foremen, team leaders or gang bosses, engineers, etc. This was not the case in the workman's compensation insurance sample where 'Labourer' was the most prevalent occupation category injured for both cohorts. 'Carpenter' was the trade next most prone to injury, also for both cohorts. Of the construction workers themselves, general workers reported that they were most prone to injuries. Injury trends by trade were comparative for both cohorts.

The analysis of the construction company injury data, the workman's compensation claims data as well as the workers' interviews found very little evidence of event-specific injuries to older workers. The events leading to the most injuries were similar for both younger and older workers being: struck by; strike against; caught in/on/between and falls, on different level and on same level. It can therefore be concluded that there was no clear evidence of any differences between the events that cause injuries to younger and older workers.

The types of injuries (nature of injury) responsible for the most injuries in both younger and older workers for the construction company sample, compensation insurance sample and worker interviews were 'Superficial wounds', 'Penetrating wounds', 'Muscle injury' and 'Bony injury'. Bony injuries were not found to be more frequent amongst older workers. There were therefore no indications of age-specific differences between younger and older workers for nature/type of injury. It is however worth noting that injury records revealed four cases of noise-induced hearing loss – all among older workers as well as silicosis and dermatitis cases also detected in the older group alone. This study did not investigate health related conditions and diseases and the potential variances between younger and older workers.

The body parts most affected due to injuries were similar for both the older and younger groups: finger; eye; trunk; and hand. This was apparent in the construction company sample, the compensation insurer sample and was confirmed by the construction workers in the analysis of the interviews conducted with them. Trunk injuries included back related injuries and were higher amongst older workers in all three samples. Knee injuries were also more prevalent amongst older workers. It can therefore be concluded that back injuries and knee injuries are more prevalent amongst older workers.

5.4.3 Injuries sustained by older construction workers are of a more serious nature compared with younger workers

The findings of data from the construction company sample, the compensation insurers claims data, the construction workers' interview responses as well as the construction site managers' perceptions were analysed. The findings were somewhat varied in that analysis of the construction company sample found that older workers were less prone to serious injuries and that they were off work for less days on average due to their injuries. The analysis of the injury claims data (FEM sample) found that older worker injuries cost considerably more on average by some 41%. Construction workers indicated that they sustained less serious injuries but that they lost more work shifts on average due to their injuries. Construction managers were of the opinion that older workers were less prone to serious injuries in line with their perception that older workers were less prone to injuries in general. It can therefore be concluded from the data analysed that older workers are neither more prone to serious injuries nor less prone. The most conclusive finding may however be the cost of injuries being considerable higher amongst the older cohort.

5.4.4 The cost of injuries is higher among older construction workers

The analysis of 1492 injury claims found that the average cost of older worker injuries was substantially higher than for younger workers. The average cost per claim was R5,500 for older workers compared with R3,243 for the younger group. This was confirmed by the analysis of the construction company sample which found older worker injuries to cost on average R2,689 compared with younger worker injuries which cost on average R2,211. Motor vehicle accidents as a event leading to injury represented a significantly higher average cost among older workers. Bony injuries as a nature/type of injury represented a substantially higher average cost among older workers. Knee injuries as a body part affected represented a significantly higher average cost among older workers. The injury costs described above are limited to direct insured costs and fail to include the hidden, indirect costs which are not easily quantifiable. Based on the literature (Hinze, 2006; Hinze, 1994; Grossman, 1991) indirect injury costs range anywhere between 0.23 and 20 times the direct costs. It can therefore be deduced that older worker injury claims when inclusive of the hidden costs could escalate to somewhere in the region of R55,000 using a factor of 10 for the hidden costs. It can therefore be concluded that older construction workers are responsible for substantially higher injury costs compared with younger construction workers.

5.4.5 Older construction workers receive less training compared with their younger counterparts

It is not disputed that training increases productivity, improves quality and reduces the risk of injury (Lew and Carpenter, 1997). Using this as a premise, construction workers were asked to comment on training received as well as whether they had ever been refused training and whether age was perceived to be an influencing factor. Both older and younger workers had received some form of training in the past. It was the older workers who responded that they had been refused training. This was prevalent in 31% of the responses compared with 5.6% of the younger worker responses. Older workers also felt in 38.5% of the responses that their age was a contributing factor for them being refused training. Construction site managers confirmed that older workers received less training than their younger counterparts. The statement was affirmed in 72.2% of the responses. It can therefore be concluded that older workers are exposed to less training opportunities compared with younger workers.

5.5 Limitations

The literature review found that limited research had been conducted on the plight of older construction workers and the injuries typically suffered by them. Substantially more literature was available on the health related situation of this group.
The study was limited to the Western Cape Region of South Africa. A single construction company's injury statistics was analysed. Injuries analysed were also restricted to certain trades and occupations with the aim of sampling only those workers who are exposed to construction related hazards on a continuous basis i.e. working out on site and not in the site office. Trades were therefore limited to: general workers; shutter hands; carpenters; bricklayers; plasterers; painters; scaffold erectors; and similar occupations and purposefully omitting injuries to such occupations as drivers, machine operators and store men. The definition of older worker was limited to age as the only parameter. This was due to other parameters such as work experience being unavailable in the data samples. The categories of injuries (events leading to injuries, nature of injury, and body parts affected) were limited to the most frequent ones identified in the samples analysed. The agents involved (machine types, plant, structures) in the injuries were not analysed. Although language was identified as a possible limitation when conducting worker interviews, it was overcome by making use of site safety & health officers who were conversant in English, Afrikaans or Xhosa. It was found that even though the safety & health officers attended a workshop explaining the worker interview process, some questionnaires did not have all the questions answered. This was however a small minority. Responses to the construction site manager questionnaires were limited to a 64.3% return rate. The site managers represented nine construction companies

considered to be amongst the larger companies operating in the Western Cape region. Smaller companies were not approached to take part in the study due to lack of site infrastructure and time constraints.

5.6 Recommendations proposed by this research study

The study proposes a combination of interventions based on the literature reviewed and the findings of the data analysed. Training is probably the most obvious intervention and will more than likely offer the most immediate impact being reduction of older worker injuries. Although it is evident from the study that older workers do not necessarily suffer specific age related injuries, the injuries sustained by them are substantially more costly and result in more workdays being lost on average. Reducing older worker injuries is a direct cost saver and therefore makes good business sense. Training should be a combination of safety and health related training and skills based job task training. Most training takes place when a worker is younger and then tapers off with the expectation that the worker is conversant with the job. Ongoing re-enforcement and up-skilling has proven to be instrumental in maintaining a high level of worker production, quality and safety and at the same time reducing injury risk.

Medical interventions in the form of pre-employment medicals and annual medical checkups will serve to ascertain a worker's level of physical and mental fitness for the job. The older the worker, the more important these interventions become should any problems be successfully managed. Failure to identify physical and/or mental problems will result in them becoming exacerbated and therefore leading to a negative impact on productivity levels as well as increasing the risk of injury to the worker as well as to other workers. Post-employment medicals are also an important company intervention which is often misunderstood and therefore not practised in the industry. Post-employment medicals serve to alert the company to the worker's medical condition on departure so that any future injury and occupational disease related claims may be avoided or foreseen and catered for. Injuries and occupational diseases/conditions sustained during employment at a particular company will remain the liability of that Employer and could result in large ongoing insurance claims costs which need to be foreseen should the company seek to manage its costs effectively.

In an effort to reduce older worker injuries, it may be beneficial to consult them as a group by introducing older worker forums where their problems and related solutions can be discussed and debated. One must keep in mind that due to the global demographic trend of an ageing workforce, a larger proportion of the construction industry into the future will constitute workers over the age of forty. The management of this cohort will therefore only become more important should injury costs be successfully reduced and managed.

Construction companies need to start utilising detailed, effective injury investigation strategies in a serious effort to understand what is causing the injuries within their organisation and in particular what is causing injury to the older workers in their organisation. Injury investigations are more often than not superficial without the necessary objective input and therefore very seldom identify the real causes of injuries. Injury investigations need to be conducted by a team of investigators with a common goal. These individuals must be properly trained on investigation strategies and protocols. Prevention of similar injuries in the future should be the common goal. With this as a real possibility, reduction of older worker injuries together with their associated high average cost per injury, found to be double that for younger workers will prove to be an effective cost saver for the organisation.

In association with effective injury investigations is the accurate calculation of injury costs. This is often neglected and is only done by the workman's compensation insurers. Organisations should adopt a recognised injury cost calculation strategy with the aim of integrating the direct injury costs with the hidden costs. The calculation strategy doe not need to be complicated and can discount those hidden costs which are too difficult to quantify. The aim of such intervention should be to convince upper management of the real injury costs impacting on the organisation so that the necessary investment can be made to eliminate or at least minimise the injuries as far as practicable.

Construction site managers and foremen could be made aware of hazardous tasks and activities which have a higher risk of leading to older worker injuries. An example as found by this study is that older workers are prone to higher rates of back related injuries as well as knee injuries to name two. The associated costs of these injuries are high and this should be incentive enough to reduce them. Back and knee injuries among other musculo-skeletal injuries are a result of overexertion due to manual work and are compounded over time. It may be pertinent for organisations to move workers out of general worker / labourer job tasks before such workers show the symptoms of these muskulo-skeletal injuries. This is obviously not always possible, however the mere knowledge and acceptance of this older worker condition and the associated management of job tasks such as improved manual and mechanical lifting interventions will go a long way in improving the situation.

5.7 Recommendations for future study

The direct costs of injuries as recorded by workman's compensation insurers and construction companies alike include medical costs and work shifts lost. The analysis of the FEM injury claims costs was not divided into medical costs and work shifts lost and it is felt that further investigation into this particular parameter would be beneficial to further support or reject the hypothesis that older workers are more prone to serious injuries compared with younger workers. The literature study made reference to pre and post accident costs and the accurate calculation thereof as a tool to convince decision makers that prevention of accidents is the only solution. Further investigation into safety & health investments made by organisations as pre-accident costs could prove beneficial to industry.

The occupation categories selected for this study were limited to certain trades. It is felt that further study could be undertaken to investigate occupations such as construction vehicle drivers, construction plant operators and store men. Construction site management officials such as team leaders (gang bosses), foremen, site managers, site engineers and the like should also be investigated for older worker related injuries and medical conditions which could negatively impact on their effectiveness.

Apart from the future research proposed, it is hoped that this study will add valuable research material to the somewhat limited literature available on the topic. It is also envisaged that the research findings will be utilised by construction organisations and other interested parties so that injuries to construction workers and in particular to older workers can be successfully minimised with the ultimate goal being elimination of these injuries altogether.

APPENDIX A: REQUEST FOR INFORMATION E-MAIL LETTER – WORKMAN'S COMPENSATION INSURER

Marius

From: Marius [marius@eppen-burger.co.za]
Sent: Tuesday, May 06, 2008 3:20 PM
To: 'rodsa@fema.co.za'
Cc: 'geraldm@fema.co.za'
Subject: injury statistics

Rod,

My previous e-mails refer.

I am busy trying to complete my Masters Degree in Construction Management – health & safety. The title of my dissertation is: Older construction workers – A study of related injuries, underlying causes and estimated costs.

I am therefore in search of claims statistics that highlight in particular:

1. Age of injured person
2. Trade
3. Cost of claim to date
4. Days off work / fatality
5. Event leading to injury
6. Nature of injury
7. Body part affected

The stats could be from the Cape Region alone and for a four year period say 2002 – 2005 or similar.

Please let me know whether this would be possible. I will also be able to workshop my findings with your organization – my preliminary findings show that there is some valuable info that could be learnt from this research.

Regards

Marius Eppenberger
Eppen-Burger & Associates
Construction health & safety planners
073 333 4313
021 914 1189 tel/fax

10/23/2008

APPENDIX B: WORKMAN'S COMPENSATION INSURER'S CLAIMS DATA (EXAMPLE OF FORMAT UTILISED)

OCCUPATION	NATURE	CAUSE	LOCATION	CLAIMS	COST
'9 OTHER-MASON	MULTIPLE INJURIES.	FALL ON TO DIFFERENT LEVELS	HEAD,FACE,NECK,LIMB,TRUN	R	1,350.00
'2 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	THORAX-EXC.SPINAL REGION	R	1,488.39
'1 LABOURER	PENETRATING WOUNDS.	STRUCK BY	EYE & ORBIT	R	658.77
7 CARPENTER,JOINER,SHOPFITTER	JOINT INJURY (E.G. DISLOCATION, SPRAIN, INJURY TO CARTILAGE).	SLIP OR OVER-EXERTION	WRIST	R	1,947.43
6 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	FALL ON TO DIFFERENT LEVELS	LEG,FIBULA,TIBIA	R	358.28
4 PLUMBER	PENETRATING WOUNDS.	STRUCK BY	BACK OF HAND	R	978.18
3 CARPENTER,JOINER,SHOPFITTER	BONY INJURY (E.G. FRACTURE, TUMOUR).	FALL ON TO SAME LEVEL	SINGLE FINGER	R	1,034.84
3 ROOFER	PENETRATING WOUNDS.	STRUCK BY	FOOT EXC. TOES	R	150.20
2 LABOURER	PENETRATING WOUNDS.	STRUCK BY	SKULL & SCALP	R	949.62
2 OTHER-OPERATOR	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	SKULL & SCALP	R	790.89
1 CARPENTER,JOINER,SHOPFITTER	BONY INJURY (E.G. FRACTURE, TUMOUR).	STRUCK BY	TOES(1 OR MORE)	R	2,216.28
1 CARPENTER,JOINER,SHOPFITTER	MULTIPLE INJURIES.	FALL ON TO DIFFERENT LEVELS	TRUNK & UPPER LIMB(S)	R	1,677.94
1 OTHER-LABOURER	MUSCLE INJURY (E.G. STRAIN, TORNLIGAMENTS, MUSCLES, TENDONS).	SLIP OR OVER-EXERTION	SHOULDER	R	809.82
0 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	FOOT EXC. TOES	R	381.50
0 LABOURER	PENETRATING WOUNDS.	STRIKING AGAINST	FOOT EXC. TOES	R	5,721.01
0 LABOURER	PENETRATING WOUNDS.	STRUCK BY	TWO OR MORE FINGERS	R	389.84
9 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	HEAD,FACE,NECK,TRUNK	R	1,796.68
9 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	EYE & ORBIT	R	482.12
9 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	FOOT EXC. TOES	R	258.76
9 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	THORAX-EXC.SPINAL REGION	R	1,415.39
9 LABOURER	BONY INJURY (E.G. FRACTURE, TUMOUR).	STRUCK BY	FOOT INC. TOES	R	2,670.83
9 LABOURER	MULTIPLE INJURIES.	STRUCK BY	HEAD,FACE,NECK,LIMB(S)	R	1,260.41
9 OTHER - ELECTRICIAN	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	TWO OR MORE FINGERS	R	291.71
8 OTHER-ROOFER	PENETRATING WOUNDS.	STRUCK BY	FOOT INC. TOES	R	327.58
8 OTHER-ROOFER	PENETRATING WOUNDS.	STRIKING AGAINST	SINGLE FINGER	R	350.40
8 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	THUMB	R	492.00
8 PLUMBER	PENETRATING WOUNDS.	STRUCK BY	LEG,FIBULA,TIBIA	R	19,411.63
8 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	TWO OR MORE FINGERS	R	1,617.57
8 CARPENTER,JOINER,SHOPFITTER	BONY INJURY (E.G. FRACTURE, TUMOUR).	STRUCK BY	FOOT INC. TOES	R	8,431.10
8 OTHER-LABOURER	MULTIPLE INJURIES.	FALL ON TO DIFFERENT LEVELS	HEAD,FACE,NECK,TRUNK	R	5,213.71
8 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	EYE & ORBIT	R	921.85
8 CARPENTER,JOINER,SHOPFITTER	PENETRATING WOUNDS.	STRUCK BY	EYE & ORBIT	R	1,169.16
8 PAINTER, DECORATOR	PENETRATING WOUNDS.	STRIKING AGAINST	SINGLE FINGER	R	742.62
7 OTHER-ROOFER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	FALL ON TO DIFFERENT LEVELS	SHOULDER	R	422.86
7 LABOURER	PENETRATING WOUNDS.	CAUGHT IN,ON,BETWEEN	MULTIPLE TO 1 HAND	R	1,208.84
7 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	FOOT INC. TOES	R	1,601.33
7 LABOURER	AMPUTATION OR REMOVAL OF ORGAN .	CAUGHT IN,ON,BETWEEN	THUMB & 1/MORE FINGERS	R	30,305.20
7 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	CAUGHT IN,ON,BETWEEN	MULTIPLE TO 1 HAND	R	1,307.72
7 LABOURER	MUSCLE INJURY (E.G. STRAIN, TORNLIGAMENTS, MUSCLES, TENDONS).	FALL ON TO SAME LEVEL	ABDOMEN-INC.LUMBAR SPINE	R	1,388.92
7 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	FALL ON TO DIFFERENT LEVELS	ABDOMEN-INC.LUMBAR SPINE	R	522.00
7 OTHER-LABOURER	MUSCLE INJURY (E.G. STRAIN, TORNLIGAMENTS, MUSCLES, TENDONS).	STRUCK BY	NECK(INC. THROAT)	R	401.14
6 RIGGER	BONY INJURY (E.G. FRACTURE, TUMOUR).	STRUCK BY	TOES(1 OR MORE)	R	727.06
6 LABOURER	JOINT INJURY (E.G. DISLOCATION, SPRAIN, INJURY TO CARTILAGE).	FALL ON TO SAME LEVEL	KNEE JOINT	R	1,545.38
6 LABOURER	PENETRATING WOUNDS.	STRIKING AGAINST	FOOT INC. TOES	R	691.37
6 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	LEG,FIBULA,TIBIA	R	1,418.53
6 OTHER-MASON	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	FALL ON TO DIFFERENT LEVELS	KNEE JOINT	R	829.45
6 LABOURER	JOINT INJURY (E.G. DISLOCATION, SPRAIN, INJURY TO CARTILAGE).	FALL ON TO DIFFERENT LEVELS	MULTIPLE(TO TRUNK)	R	3,743.16
6 OTHER-CARPENTER	PENETRATING WOUNDS.	STRUCK BY	THUMB	R	309.55
6 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	THIGH-FEMUR	R	359.43
6 CARPENTER,JOINER,SHOPFITTER	MUSCLE INJURY (E.G. STRAIN, TORNLIGAMENTS, MUSCLES, TENDONS).	SLIP OR OVER-EXERTION	ABDOMEN-INC.LUMBAR SPINE	R	1,709.91
6 LABOURER	PENETRATING WOUNDS.	STRIKING AGAINST	LEG,FIBULA,TIBIA	R	9,477.64
6 LABOURER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	FALL ON TO SAME LEVEL	KNEE JOINT	R	608.15
6 OTHER-CARPENTER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	FALL ON TO DIFFERENT LEVELS	MULTIPLE TO 1 HAND	R	3,686.02
5 ROOFER	SUPERFICIAL WOUNDS (INCLUDE BURNS AND SCALDS).	STRUCK BY	ELBOW	R	12,876.97

APPENDIX C: CONSTRUCTION COMPANY'S INJURY DATA (EXAMPLE OF FORMAT UTILISED)

WBHO CONSTRUCTION CAPE (PTY) LTD
ACCIDENT STATISTICS

MONTH SEPTEMBER YEAR 2005

LDIFR = LD INCIDENTS X 1 000 000 / MANHOURS WORKED

									(eye)		
North Wharf 3380	S.L. Mbokotwana (27) (Gen. worker) 09. 05. 77	28.09.05	Casual	-	1	Still off	While cleaning next to waste skip, brick got of the waste chute & hit him on his arm. (5)	Fracture (7)	R- thumb (7)	15 415	64.9
Pick 'n Pay 8100393	S.B. Motale (Shutter hand) (46) 1957-06-25	28.09.05	16.08.81	1	-	-	While guiding shutter that were lifted by crane, shutters knocked against the wall & knocked finger. (4)	Laceration (2)	R- index & middle fingers (7)	20 710	-
Mandela Rhodes 4322	W. Dyani (44) (Gen. worker) 1960-03-24	29.09.05	15.11.04	1	-	-	While erecting deck, he got trapped onto a floor hole & fell with his chest. (3)	Bruising (2)	Chest. (3)	9 293	-
Pick 'n Pay 3150	S. Booi (Gen. worker) (23) 05.06.79	03.10.05	07.07.05	1	-	-	While the vibrator was lowered by crane & trying to keep it in position, poker dislodged & hit his nose. (5)	Laceration (2)	Nose (14)	20 710	-
Pick 'n Pay Labour intensive	X. Sipopo (Gen. worker) (34) 06.01.71	03.10.05	Labour intensive (Rodatk)	1	-	-	While dismantling doka tables, tables dislodged & fell onto his head. (5)	Bruising (2)	Forehead (1)	2 408	-
Knights Bridge 2993	S.M. Madladla (25) (Labour) 1979-10-10	04.10.05	04.05.05	1	-	-	While stripping a wall, he was accidentally knocked by mobile crane hook. (5)	Sprain (6)	R- foot (9)	27 401	-
Eventide 1924	D.D. Cowley (Lnr Carpenter) (20) 14.09.84	26.09.05	01.09.03	1	-	-	While loosening the bundle of shutter from a chain sling, shutter slipped & caught his finger. (4)	Minor bruise (2)	L-mid finer (7)	16 857	-
Icon 1498	T.B. Vellem (52) (mixer operator) 1952-05-06	05.10.05	04.03.02	1	-	-	While casting concrete, his arm got caught by chute of concrete truck. (4)	Bruising (2)	L-arm (5)	15 092	-
Pick 'n Pay 8100383	N. M. Nase 1948-05-02 (56)	06.10.05	05.01.81	1	-	-	While casting a concrete, he (2)	Punctured (1)	R- (14)	20	-

(9)

APPENDIX D: CONSTRUCTION WORKER INTERVIEW – QUESTIONNAIRE EXAMPLE

OLDER CONSTRUCTION WORKERS: WORKERS' QUESTIONNAIRE

July 2008 (4 pages; 14 questions)
Respondent number: __________________
Interviewer: ___________________________ Date: _______________

---

1. How old are you?

_______________ Years ________________ Months

2. How long have you worked:

	Category	Years	Months
2.1	In construction		
2.2	For current employer		
2.3	In other industries		

3. In what capacity are you employed in construction?

	Trade	
3.1	General worker	
3.2	Shutter hand	
3.3	Carpenter	
3.4	Bricklayer	
3.5	Plasterer	
3.6	Painter	
3.7	Roofer	
3.8	Other	

4. What is your level of education?

	Education level	
4.1	0 (no formal education)	
4.2	Sub A – Standard 5	
4.3	6-8(Std)	
4.4	9-10(std)	
4.5	Technical college	
4.6	Other	

5. What is your home language?

	Language	
5.1	Xhosa	
5.2	English	
5.3	Afrikaans	
5.4	Other	

6. Can you read and write in your home language?

Yes	No

7. Can you read and write in English?

Yes	No

---

8. Have you sustained any construction related injuries?

Yes	No

8.1. If 'Yes', how many injuries?

	Injuries	
8.1.1	1	
8.1.2	2-5	
8.1.3	6-10	
8.1.4	>10	

8.2. What type(s) of injuries have you sustained and how old were you at the time?

	Type	Injury	Age
8.2.1	Superficial (burns, bruising, lacerations)		
8.2.2	Muscle injury (strains)		
8.2.3	Joint injury (sprains)		
8.2.4	Bone injury (fracture)		
8.2.5	Amputation		
8.2.6	Penetrating wounds (eyes, puncture wounds)		
8.2.7	Multiple injury		

8.3. What event(s) led up to your injury(s) and how old were you at the time?

	Event	Injury	Age
8.3.1	Fall onto same level		
8.3.2	Fall onto different level		
8.3.3	Overexertion		
8.3.4	Caught in/on/between		
8.3.5	Striking against an object		
8.3.6	Contact with extreme temp.		
8.3.7	Contact with electricity		
8.3.8	Struck by object		
8.3.9	Accident N.E.C		

8.4 What body part(s) were affected and how old were you at the time?

	Body Part	Injury	Age
8.4.1	Head (exclude eyes & ears)		
8.4.2	Neck		
8.4.3	Trunk (torso, ribs, back)		
8.4.4	Shoulder		
8.4.5	Arm		
8.4.6	Hand (incl. wrist)		
8.4.7	Finger		
8.4.8	Leg		
8.4.9	Foot		
8.4.10	Knee		
8.4.11	Ankle		

8.4.12	Eye		
8.4.13	Multiple		
8.4.14	Other		

9. Of the injuries sustained by you, how would you categorize the most serious one, how many days were you off work if applicable, and how old you were you at the time?

	Category	Yes	No	Days off work	Age
9.1	Disabling injury (off work for one full shift or more)				
9.2	Medical case (doctor, but not off work)				
9.3	First aid only				
9.4	Occupational condition / disease				

---

10. Have you ever undergone any of the following, and if so, how many times?

	OH Intervention	Yes	No
10.1	Pre-employment medical		
10.2	Intermediate medical (during employ.)		
10.3	Post-employment medical		
10.4	Working at heights evaluation		

11. Have you ever received any of the following training?

	Training	Yes	No
11.1	Skill-specific training (trade specific)		
11.2	H&S training (class room)		
11.3	Induction training (site)		
11.4	Toolbox talk training (informal)		
11.5	Fall prevention training		
11.6	Training on the use of tools and machines		

12. Do you think training would help to lower the chance of you getting injured?

Yes	No

12.1 If 'Yes', what training would be the most beneficial to you and which do you think would be the least? Choose the one category which is the most and one which is the least.

	Training	Most	Least
12.1.1	Skill training (trade)		
12.1.2	H&S training (class room)		
12.1.3	Induction training		
12.1.4	Toolbox talk training		
12.1.5	Fall prevention training		
12.1.6	Training on the use of tools and machines		

13. Have you ever asked for training and been refused?

Yes	No

13.1. If ‘Yes’, do you think that your age was a reason for you being refused the training i.e. do you think you were too old?

Yes	No	Unsure

14. When you received training, did you understand what was being discussed?

Yes	No	Unsure

14.1 If you didn’t understand, was this because you didn’t understand the language used?

Yes	No

APPENDIX E: REQUEST FOR INFORMATION E-MAIL LETTER – CONSTRUCTION SITE MANAGERS

Marius

From: Marius [marius@eppen-burger.co.za]
Sent: Friday, August 08, 2008 3:19 PM
To: 'jamesw@wbhosites.co.za'
Cc: 'james_welman@wbho.co.za'
Subject: SAFETY - construction injuries

James,

I need to ask you a **favour**. I'm busy with a **Masters Thesis** looking at construction injuries. Apart from the injury data bases analysed and workers interviewed, I need to collect some data from construction managers and have attached a fairly brief questionnaire for your attention.

I know you're time strapped but never the less hope that you'll find some time to look at the questionnaire and complete by the **18th August**. It's mostly yes-no answers with some explanations in places – see attachment. Please answer all questions.

You can answer directly on the questionnaire and e-mail back or print out, fill in and fax back to me (021 914 1189).

Your input will be greatly appreciated.

Look forward to your responses.

Thanks

Marius Eppenberger
Eppen-Burger & Associates
Construction health & safety planners
073 333 4313
021 914 1189 tel/fax

APPENDIX F: CONSTRUCTION SITE MANAGER – QUESTIONNAIRE EXAMPLE

OLDER CONSTRUCTION WORKERS: MANAGERS' QUESTIONNAIRE

July 2008 (4 pages; 12 questions)
Respondent number: ________________
Position in Company: ______________________ **Date: ______________**

1. How old do you consider an older worker to be in years?

30 yrs<	40 yrs<	50 yrs<

2. Who would you say are more productive, younger or older workers?

	Younger	Older	Both	Unsure
2.1				

3. Who do you think are more prone to injuries, younger or older workers?

	Younger	Older	Both	Unsure
3.1				

4. Who do you believe are more prone to serious injuries (person off for more than 14 days), younger or older workers?

	Younger	Older	Both	Unsure
4.1				

5. Is the cost of injuries on average higher among younger or older workers?

	Younger	Older	Both	Unsure
5.1				

6. What do you think the average cost of a construction injury is – choose one category?

	Cost category	
6.1	R1-1000	
6.2	R1001-3000	
6.3	R3001-5000	
6.4	R5001-10000	
6.5	R10000<	

7. Are you aware of any company policies on the specific management of older workers i.e. interviews, regular company medicals, older worker forums, training programs.

Yes	No	Unsure

7.1 If 'Yes', what are they?

____

____

8. Who do you think on average receives more training, younger or older workers (while in that age group)?

	Younger	Older	Both	Unsure
8.1				

9. Does your company implement any medical programs?

Yes	No	Unsure

9.1 If 'Yes', what are they?

	Program	Yes	No
9.1.1	Pre-employment		
9.1.2	Intermediate (annual)		
9.1.3	Post-employment (exit)		
9.1.4	Working at heights		
9.1.5	HIV/AIDS		
9.1.6	Other		

9.2 If 'Other', what medical programs are these?

____

____

10. Indicate to what degree you agree/disagree with the following statements.

10.1 Older workers are valuable to the construction industry

10.1.1	Strongly disagree	
10.1.2	Disagree	
10.1.3	Neutral	
10.1.4	Agree	
10.1.5	Strongly agree	

10.2 Older workers are more valuable than younger workers.

10.2.1	Strongly disagree	
10.2.2	Disagree	
10.2.3	Neutral	
10.2.4	Agree	
10.2.5	Strongly agree	

10.3 Older workers add limited value to the construction industry

10.3.1	Strongly disagree	
10.3.2	Disagree	
10.3.3	Neutral	
10.3.4	Agree	
10.3.5	Strongly agree	

10.4 Older workers tend to work safer than younger workers

10.4.1	Strongly disagree	
10.4.2	Disagree	
10.4.3	Neutral	
10.4.4	Agree	
10.4.5	Strongly agree	

11. Would you support older worker programs aimed at maximizing their potential?

Yes	No	Unsure

11.1 If 'Yes', what specific programs would you support?

	Program	Yes	No	Unsure
11.1.1	Regular interviews / assessments			
11.1.2	Older worker forums / committees			
11.1.3	Regular medicals			
11.1.4	Increased training (safety/job)			
11.1.5	Redeployment to other tasks / occupations			
11.1.6	Other			

11.2 If 'Other', what would you propose?

____

____

12. Are you in favor of increasing the pensionable age to beyond 60 years or shortening it to be lower than 60 years, or do you think it is adequate as it is?

	Personable age	Yes	No	Unsure
12.1	60<			
12.2	<60			
12.3	=60			

____

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BIOGRAPHICAL SKETCH

Marius Eppenberger was born on February 29, 1972 in Cape Town. He matriculated in 1989 with a university exemption after which he entered the armed forces to undergo compulsory military service. He completed the Bachelor of Technology Environmental Health at the former Cape Technikon, now the Cape Peninsula University of Technology.

Marius worked for the construction company, WBHO between 1996 and 2003 as a construction safety and health co-ordinator for the Western Cape division. He also undertook fulltime postings on two high profile projects, namely Grandwest Casino and Cape Town International Convention Centre, in the capacity of project safety and health officer. In September 2003 he started his own construction safety and health consulting practice where he has been offering his services to construction developers.

He has been a member of the Institute of Safety Management since 1998 and was a member of the South African Institute of Occupational Hygienists while practicing in the field of industrial hygiene.

His primary driving force is a passion for eliminating injuries and ill health suffered by construction workers.