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Accident denominators relative to age groups in heavy industries of the Port Hedland region of Western Australia

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ACCIDENT DENOMINATORS RELATIVE TO AGE GROUPS IN HEAVY INDUSTRIES OF THE PORT HEDLAND REGION OF WESTERN AUSTRALIA

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ABSTRACT

The aim of this research is to investigate characteristics of accident denominators across age groups in mining and associated process industries in the Port Hedland region of Western Australia. Emphasis has been focussed on comparing young, inexperienced groups with older, more experienced groups. A literature review revealed some key contributors to accidents among younger workers, in particular, those who had only recently entered the workforce. The review also revealed contributors impacting accidents regarding other age groups over a wide range of industry types. From these findings an accident construct model and questionnaire were designed to identify contributing and mitigating denominators which input to accidents occurring across the defined age groups. Accident input denominators have been defined in the theoretical framework as elements comprising the four accidents constructs which arose from the literature review. Information related to the outputs of accidents was also collected with regards to age groups and assessed for potential trends, suggesting accident outputs potentially link to input denominators.

Industrial companies local to the Port Hedland area involved in mining, associated process industries and construction were randomly selected to participate in this study.

Data was collected by administering a questionnaire in person to pre-arranged randomly selected groups from each industry. Completed questionnaires were collected immediately at points of distribution and checked for omissions, thereby minimising the potential for missing information. Accident denominator data was obtained on a Likert scale of 1 - 5 and evaluated using frequency distributions. Accident output data was coded and evaluated also using frequency distributions.

Results obtained revealed supervision, hazard identification, inadequate company safety system training and internal pressure were significant denominators contributing to the accidents experienced by the youngest age group or length of time at work. Results also revealed significant denominators contributing to the accidents experienced by the other four age groups.

Significant mitigating denominators were also identified, characteristic to age groups which have the potential to be developed into a company's safety management plan to foster appropriate safe working behaviour. If adopted, strategies arising from this study have the potential to augment current safety management systems.

DECLARATION

I certify that this thesis does not, to the best of knowledge and belief;

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1.0 INTRODUCTION

1.1 Background:

Each year in Western Australia workers suffer injuries and harm arising from preventable accidents. Unfortunately, many of these accidents still result in fatalities (Glasby, 2004) . Over past decades substantial progress by both private efforts and legislative initiatives have been achieved in the form of Company policies (Dampier Salt Limited, 2002), legislative guidelines (Mines Occupational Safety and Health Advisory Board, 2001), Australian Standards and Codes of Practice ("Occupational Health and Safety Systems," 2001), ("Code of Practice," 1996). The scope of these initiatives and consequent changes appear to be considerable. Potential improvements were sought when Western Australia adopted the Robens style legislation in 1984. However inputs from industry, unions, private institutions and individual workers may have also participated towards a common goal of reducing accident rates in the workforce.

However the level of injury and harm experienced by Australian workers is still unacceptably high and continues to result in fatalities (Glasby, 2004). Previous to the introduction of the Occupational Health and Safety Act and Regulations 1984 in Western Australia, accidents and injuries may have been considered as being an unavoidable component of the work place. The new legislation described duties of care for employers and employees whereby workers and management were assigned legal responsibilities towards safety. The duties of care responsibilities have also been embedded into other legislation such as the Mines Health and Safety Act to become legal requirements of health and safety systems throughout all Western Australian mines ("Mines safety and Inspection Act 1994," pp. 15-18).

Previous studies have indicated that young people entering the work force are at a greater risk of being injured than older, more experienced workers (Breslin, Koehoorn, Smith, & Manno, 2003; Cook, 2003; Kaine, 1997; Maynard, 2001; Persson & Larsson, 1991; Somerville, 2002; West, 2004; Youthsafe, 1999). Results indicate that there are a number of contributing factors influencing their injury rate, citing lack of supervision, directed to operate equipment without proper training and lack of safety education prior to entering the work force, (Kris, 2001).

However, other information sources indicate that workers of all age groups are still being injured, possibly suggesting that other contributing causes may be operating.

1.2 The Problem:

The existing problem that this study has investigated is *workers of all age groups are still being injured and subjected to harm at work*, even though many apparent improvements have been achieved over the past few decades. Focus was placed on a selected factors contributing to or mitigating accidents. Defined age groups were examined for comparison of injury details, such as body part affected, energy exchange involved, damage type, severity of injury (damage class) and safety awareness. The theoretical framework provides a more detailed description.

1.3 Significance of this Study:

Accidents are still occurring in Australian industries resulting in fatalities, permanent disabilities, fractures and minor injuries (Australian Bureau of Statistics, 2003, pp. 9). The hidden costs of accidents are suspected to represent a significant financial burden nation wide as well as possibly presenting a range of personal traumas to the injured and their families.

Accidents continue to occur over the entire age range of the workforce; to new starters as well as older, experienced workers (Glasby, 2004, pp. 24).

The potential benefits to be gained from study are a reduction of accidents in the workplace by:

1) Assisting relevant industries to augment current accident reduction strategies to gain further improvements.
2) Identifying specific mitigating and contributing denominators that currently input defined accident constructs, across age groups.
3) Providing information to assist in identifying and quantifying safety issues specific to young inexperienced workers.
4) Providing new information relevant to accident output dynamics across age groups and industry types.
5) Determine if people entering the work force for the first time are aware of key denominators concerning their safety whilst at work by measuring their level of “Safety Awareness”.

6) Provide an alternative method of examining accident data to assist in the identification of key factors pertaining to accident rates across age groups.
7) This study also contributes to current body of knowledge specific to workplace accidents.

1.4 Research Questions:

1) 1.4.1 Are younger, inexperienced workers subjected to more serious accidents than older groups in the work place?
2) 1.4.2 Do accident characteristics in terms of output denominators stabilise or destabilise in older age groups?
3) 1.4.3 Do input denominators to accidents vary across age groups?
4) 1.4.4 Do the outputs of accidents vary across age groups?

1.5 Purpose of the Study:

The aim of this study was to answer the proposed four research questions above and contribute to industrial safety management systems continuous improvement initiatives. By providing an alternate method of identifying key contributing and mitigating denominators to accidents, the development of safety awareness initiatives and safety culture particular to that industry may be enhanced. An alternate view of assessing accident output is also examined to provide relevant foci to assist in the above.

The purpose of this research study was also to examine the subjective issue of safety awareness, as defined in this research and to compare knowledge of key safety denominators of population groups who have yet to enter the work force with those who have entered paid employment. This information may be useful in the development in pre-work programs or enhancing current work experience programs.

1.6 Limitations to the Study:

Several limitations of this study have become evident:

1) Due to geographical concerns, the study population from which the sample was taken was restricted to the confines of Port Hedland. Therefore findings may not be relevant to other Pilbara regions of Western Australia.
2) The model used in this study was not intended to function as an accident causation or assessment tool. Nor is this research intended to provide assistance for accident investigations.

3) It does provide an alternate method for determining accident characteristics across defined age groups, in specific industry types, to better understand age group dynamics of industrial accidents.
4) The randomly selected sample consisted of approximately 60% from the mining industry and the findings arising from this report may be more applicable to mining rather than heavy industry in general.
5) Very few females were selected therefore no gender based conclusions can be reached.
6) There were no participants over the age of 65 years of age; findings from this report may not be applicable to this group.
7) Engineering and construction industries are not proportionally represented. Therefore this information is biased towards mining and this fact may confound the wider application of the findings of this report.

This project is a descriptive study of a randomly selected sample of a target populations from workers employed in mining and heavy industry in the Port Hedland region of Western Australia. Information collected was used to assess the input/output criteria relevant to the defined accident constructs and may not be applicable to the wider population outside of the Port Hedland area.

1.7 Definition of Terms:

Terminology used in this research is defined in the following glossary. These definitions are specific to this research and may have different meanings outside of this scope.

Accident - Any unplanned energy exchange that causes personal injury or equipment damage.

Accident Construct – One of four defined tools comprising of elements or denominators possessing the potential to denominator accident rates. They are defined as, *Workplace Contributing Denominators, Workplace Mitigating Denominators, Personal Contributing Denominators* and *Personal Mitigating Denominators*.

Accident Input – Any set of active denominators or single denominator inputting an accident as per the Accident Construct Table 3.2.1 pp 22.

Accident Output – Outputs of an accident as defined in Table 7.1 (a) and 7.1 (b) pp 85.

Active Denominator – Any denominator arising from the accident construct table that displays an active effect on accident input. Its effect can be contributing or mitigating. If a particular denominator has no effect on accident input, then it is not deemed to be an active denominator.

Age Group – A group of workers classified with regards to their age. The six defined age group boundaries have been arbitrarily assigned as follows:

1. 15-19
2. 20-24
3. 25-34
4. 35-44
5. 45-54
6. 55- 64

Composite Denominator – Any denominator comprising an accident construct affecting accident group dynamics. They can either be contributing, mitigating or both within a group.

Contributing Denominator – Is any denominator comprising an accident construct that has been identified as contributing to an accident either singularly or as a group dynamic.

Corrective foci – Foci originating from the analysed collected data that indicate a direction of focus for directing efforts to improve existing safety management systems.

Damage Class – Defined by Kahler and Ellis as three possible outcomes resulting from an accident, these outcomes will be considered synonymous with severity of injury (Kahler & Ellis, 2002, pp. 1-2).

1. Class One – Permanent.
2. Class Two – Temporary.
3. Class Three – Minor.

Damage Type – Defined by Kahler and Ellis in conjunction with "energy exchange involved" with regards to a specific dose of energy (time and intensity). They identified three damage types (Kahler & Ellis, 2002, pp. 5).

1. Type A – Single traumatic energy exchange.
2. Type B – A series of discrete exchanges.
3. Type C – Continuous exposure to small energy exchanges.

Denominator – Any element that comprises an accident construct.

Dichotomous Denominator - Any denominator comprising an accident construct influencing a single accident. It can either contribute or mitigate but not both.

Duty of Care – Legal responsibility assigned of management and workers to provide and maintain a safe work place.

Energy exchange – A classification of energy sources involved in an accident as per Kahler and Ellis (Kahler & Ellis, 2002, pp. 4).

Fit for Work – A term used to describe the ability for a worker to safely perform work while not under the effect of alcohol or drugs (prescribed or other) and suffering no physical or mental impairment likely to affect their ability to work safely.

Hazard - Any existing condition that has the potential to cause injury or harm to a worker or equipment.

Industry Type – One of the following five industries which were surveyed to provide data for this study:

1) Mining
2) Engineering
3) Construction
4) Manufacture
5) Electrical
6) Other

Leading Indicator – A **s**tatistical measure arising reports or observations whereby hazards are identified and corrective action take without an accident occurring.

Mitigating Denominator - Any denominator comprising an accident construct that has been identified as potentially preventing, or mitigating the effects of an accident, either singularly or as a group dynamic.

Near Miss - Any unplanned energy exchange that has the potential to cause personal injury or equipment damage but did not.

Personal Contributing Denominator – Personal characteristic that causes a person to act or work in a particular manner contrary to known safe methods of work, thereby increasing the potential for an accident to occur. This has the potential to destabilise the *accident frequency rate* of their particular age group. It is expressed as an element or denominator of the Destabilising Factor construct.

E.g., be prepared to take a short cut or infringe a safety rule.

Personal Mitigating Denominator – Personal characteristic that causes a person to act or work in a particular manner or adhere to a known safe method of work so as to avoid an accident and thereby stabilise or improve the accident frequency rate of their particular age group. It is expressed as an element or denominator of the Stabilising Factor construct.

E.g., fear of loss of job or of peers.

Primary Contact –Contact person of an industrial work site permitting workers to take part in this study. These contacts were company managers or business owners.

Risk – The likelihood that an unplanned energy exchange may occur.

Sample – Sample of workers from the defined population of age groups who have been injured at work, since the year 2000.

Significant Denominator – Any denominator (contributing or mitigating) scoring a frequency of 40% or more.

Trailing Indicator – A statistical measure derived after an accident has occurred.

Workplace Contributing Denominator - Unsafe act or condition that may have the potential to contribute to the existence of a hazard or an accident. It is expressed as an element or denominator of the Contributing Denominator construct.

E.g., Lack of supervision.

Workplace Mitigating Denominator – Safe act or condition that may have the potential to reduce or negate the effects or existence of a hazard or to prevent an accident. It is expressed as an element or denominator of the Mitigating Denominator construct.

E.g., Adequate training.

2.0 LITERATURE REVIEW

2.1 Review:

This research investigated work related accidents across defined age groups, however there may be commonality linking some parameters of accident causation to non-work related statistics; for example personal contributors and mitigators impact on out of work accidents. Due to this suspected link non work related information will also be included in the review but has not been included in the research. Also information related fatalities and the use of child labour were not included, that is, minors up to the age of 15 (Richter & Jacobs, 1991, pp. 747).

It has been recognised for some decades that younger, less experienced workers are more likely to suffer work related injuries and fatalities than older, more experienced workers. (Breslin et al., 2003, pp. 1-5); (Australian Bureau of Statistics, 2003, pp. 2) (Alsop, Gafford, Langley, Beg, & Firth, 2000, pp. 114) (Brezler, 1999, pp. 1). This trend is not just an Australian phenomenon overseas studies have revealed similar disturbing trends (Richter & Jacobs, 1991, pp. 747-769); (Knight, Castillo, & Layne, 1995, pp. 793-805) (Reason et al., 1988, pp. 4-23) (Ruser, 1998, pp. 151-156). Further more, the trends appear to be representative of both non work and work related accidents (Australian Bureau of Statistics, 2003, pp. 2). The Australian Bureau of Statistics reported age groups 0-14 and 15-24 as being the most injured groups in 2001. The results also indicated that the older the age group, the fewer injuries being sustained. The report stated that “falls and collisions were the two largest injury categories”. (Australian Bureau of Statistics, 2003, pp. 2). However a question still remains; are these trends evident in the chosen study population and industry types in the Pilbara region of Western Australia?

Breslin et al stated that “adolescents in the USA, Canada and Europe are injured at work frequently enough to consider it a public health hazard. And that these injuries occur more frequently compared to older work groups”. Age differences were particularly marked for males with adolescent males suffering 1.5 to 4 times more accidents than those over 25. They suggested that the likelihood of being involved in an accident varies by age, gender and industry type. (Breslin et al., 2003, pp. 1). They also found that male adolescent and young adult’s compensation claims were greater than older, male age groups and consistent with previous research.

However the pattern was not repeated among females of the same age groups, which indicated lower claim rates (Breslin et al., 2003, pp. 3).

In 1992 Knight et al cited that adolescent females and males treated in emergency departments had a 1.5 and 2 time the rate of work related injury compared to similar adult groups. However there was no discussion to further sub-divide the adult groups. This presents the possibility of a relatively small adolescent population of workers being compared to a potentially larger population of workers comprising the remainder of the workforce. If this was demonstrated to be the case, then the figures of 1.5 and 2 times greater may have been underestimated. Data was not supplied in terms of injuries per person year but only as percentages. They also reported that eating places accounted for 34% of the injuries sustained with food preparation and service accounting for the majority of injuries. (Knight et al., 1995, pp. 793-798).

In 1988 a study performed by The University of Manchester sought to determine factors influencing driver behaviour. Even though this study is relatively outdated and is aimed at road accidents, its findings may also be pertinent to adolescent attitudes towards safety in the workforce. Demographic variables of exposure, gender, age and lack of experience being significant contributors to road accidents (Reason et al., 1988, pp. 4-5). These three variables also appear to be significant factors in work related injuries. Workers under the age of 25 are more likely to be injured at work than older workers (Prenesti, 1996, pp. 9). In Australia 2002-2003 younger age groups suffer more fatalities than older groups (Glasby, 2004, pp. 24). In some industries young workers are being killed at work without receiving adequate training and/or adequate experience (West, 2004, pp. 6-7). Concurrent with these three criteria Blanco claims that occupational injuries are a cause of significant morbidity and mortality among young workers. The report by Reason et al also indicated that accidents involving male drivers exceeded those of female drivers; this trend also has been revealed in work related accident statistics (Reason et al., 1988, pp. 4). However a larger percentage of eligible male drivers were licensed and they tended to have an increased exposure, covering more distance on the road than female drivers, possibly confounding the results. Young drivers, 17-21 year olds comprised 4.4 percent of the driving population but were involved in 13 percent of all traffic accidents.

Inexperience was also stated as being significant but the report recognised that inexperience may be coupled with youth and concluded that inexperienced (primarily younger) drivers are more prone to accident involvement (Reason et al., 1988, pp. 4-5). It is suspected these findings may be similar to work accident statistics in the study population. The report used a tripartite topology to broadly describe immediate events prior accident. *Lapses* in concentration, such as misreading road signs or selecting the wrong gear can be embarrassing but not necessarily serious. *Errors*, such as braking too quickly or failing to check before changing lanes were not statistically significant in contributing to road accidents but could lead to minor accidents or traffic infringements. *Violations*, such as deliberately speeding, angry behaviour or driving under the denominator of alcohol, were major contributors. The report concluded that violations are the major contributors to accidents (Reason et al., 1988, pp. 6-9). The theoretical framework of this research proposal will include violations as a possible contributing denominator.

Workers under the age of 25 are more likely to be injured than older workers (Prenesti, 1996, pp. 26). Prenesti goes on to claim contributing factors such as inexperience, insecurity, poor training and exploitation status on injury rates. He further claimed that younger workers are not fully aware of their rights and easily intimidated, suggesting that they are more easily manipulated into performing unsafe tasks than older workers (Prenesti, 1996, pp. 27). The article appeared to present an anecdotal approach to issues perceived to be affecting accident rates on young workers. It appeared to fail in presenting any new information or by presenting validating data from cited sources.

Young workers may suffer elevated levels of accidents and injuries because of a “rush to grow up”. The primary risk they take is simply trying to grow up too fast (Wortham, 1998, pp. 88). Because a teenager’s body is still developing they may be more susceptible to some injury types than fully developed adults (Wortham, 1998, pp. 90). This report also emphasises the need for adequate training and supervision for teenage workers. Anecdotal data presented appears to be raising valid concerns regarding training and supervision, therefore it is suspected that these two parameters should be included in this proposal as the number of injuries sustained by young workers is still disproportionately high (Kaine, 1997, pp. 24).

Youthsafe identified the most common industries experiencing fatalities in Australia and concluded that the construction industry accounted for 21 percent, agriculture 15 percent and manufacturing 14 percent. The National Occupational Health and Safety Commission (NOHSC) reported on the causes of fatalities among the 16-19 year old group. They reported vehicle accidents accounted for 32 percent, electrocution 16 percent, falls 13 percent and being struck 16 percent (Youthsafe, 1999, pp. 1-2).

More recent statistics from Western Australia appear to be reiterating the problems associated with the inexperience of young workers, claiming that 1 in every 11 young males and 1 in every 5 young female are injured while still new on the job. It can still be demonstrated that young workers are being killed at work without receiving adequate training (West, 2004, pp. 6-7). This article also emphasised the lack of safety training being provided by employees to young workers. However, it also quoted 34 percent of the surveyed population had experienced harassment and bullying perpetrated by persons in authority. Respondents failed to report incidents and unsafe conditions to management for fear of retribution and it is suspected they may be reluctant to ask questions or raise safety concerns for the same reason (West, 2004, pp. 8-9).

Maynard stated that “work poses specific hazards for young workers and that a third of young workers are not given adequate safety training” (Maynard, 2001, pp. 20). She also suggested some areas for attention before employing young inexperienced workers: the work should not be beyond their capability, physically or mentally; the work should not involve exposure to harmful denominators that may adversely affect the future health of the worker; should not involve work exposing workers to hazards that they may not recognise; or involve risk to health from any extreme environmental exposure. She suggested employees conduct a risk assessment of the areas where young, inexperienced employees may be working. (Maynard, 2001, pp. 21). However she appears to overlook the potential benefits of conducting a site wide hazard register which could potentially document all recognised hazards. It just may be possible that quality risk assessments might depend on prior recognition of the hazards present. Maynard states that some companies may have already carried out risk assessments to identify hazards and have taken appropriate measures to eliminate them (Maynard, 2001, pp. 21). I cannot agree with this line of logic.

I suspect that workplace hazards should first be recognised and then a risk assessment should be performed to determine the *residual risk* to the worker *after* specific risk control measures have been put in place. Two points which Maynard emphasises are as follows: inadequate training and supervision has been instrumental in many accidents involving young workers; and young people should be involved in the risk assessment process. (Maynard, 2001, pp. 21).

Fatal and serious injuries are still occurring to young workers (Magazine, 2004, pp. 10-11). A young, recently hired, factory hand suffered a fatal crushing injury while cleaning the inside of a moulding machine. Inadequate guarding and inexperience were identified as contributing factors. An apprentice linesman received a non fatal 22,000 volt shock from a falling power line. Inexperience was cited as a contributing factor. A Victorian magistrate has warned that apprentices should receive higher levels of supervision after an apprentice's hand was caught in an unguarded bread moulding machine (Magazine, 2004, pp. 10-11) .

Dehaas cited a number of fatal accidents involving young workers in the age group of 15-21 years old, engaged in part time holiday work in Canada. The accident types were varied, ranging from burns, crush injuries to engulfment (Dehaas, 1996, pp. 51-52). Dehaas indicated that not every job in the workplace is suitable for young, inexperienced workers. He went on to highlight that training and supervision are critical to the safety of young workers. The induction process must address issues of workplace hazards and safety training and that job design is appropriately suited to the worker performing the task. He also mentioned the need to spread training over an appropriate period of time to avoid information overload, raising the question of determining who should perform the training and assessing (Dehaas, 1996, pp. 54-55). I suspect he may have been hinting at a form of competency based training for both worker and trainer assessor but did not clearly state this. However he did emphasis that the first thing new workers should learn is *how to protect themselves,* by not attempting any task they have not been trained to do safely. He also concluded that adequate supervision may be the most important duty the workplace can provide. (Dehaas, 1996, pp. 55). His article seemed to hint at Duty of Care responsibilities on behalf of the employer and employee but seemed falter in developing the argument in those terms. However, his reference to training and supervision of young workers appears to be valid.

According to the National Safety Council accident injuries are the sixth cause of fatalities of people over 65 years of age in America (Philson, 1990, pp. 40). The possible significance of this dated information is that it is likely that the proportion of people over 65 remaining in the workforce may increase with time. Philson predicted such an increase (Philson, 1990, pp. 41). He cited that one study indicated that members of this age group were found to die from disabling injuries such as hip fractures, with falls being a significant contributor (Philson, 1990, pp. 41). If similar trends are occurring in Australia then the 65 and older may present a legitimate age group for comparison in this proposal. However they are not included in this research as none were available in the samples selected.

In 2001 Rix reported that there was a distribution in the proportion of work injuries suffered across defined age groups in America. She stated: (Rix, 2001, pp. 7)

1) 16-19 year old group accounted for 3.5 percent of total occupational injury work loss.
2) 20-24 year old group for 11.6 percent of injuries.
3) 25-34 year old group for 28.2 percent of injuries.
4) 35-44 year old group for 28.2 percent of injuries.
5) 45-54 year old group for 18.0 percent of injuries.
6) 55-64 year old group for 7.6 percent of injuries.
7) Over 65 for 1.2 percent of injuries.

As these figures are percentages only and do not appear to be linked to person years, it is possible that the 65+ age group scored so low because there may be proportionately less of them in the workplace. Though the figures are suggestive of the possibility of a trend with regards to accident rates across age groups the concept did not appear to be apparently obvious.

Breslin, et al, 2003, also stated that it is unclear whether the severity of injuries sustained also varied across age groups, citing that severity could be defined as an injury resulting in a permanent disability. (Breslin et al., 2003, pp. 1). I disagree with this definition for this research proposal as I suspect that confining the definition of serious to ”disabling injuries” may exclude other injuries which could also be deemed as serious.

The subjective character of the term “serious” potentially, may leave too much open for interpretation. In an attempt to overcome this difficulty a severity classification will be proposed aimed at mitigating the suspected subjective nature of this confounding denominator.

Kahler & Ellis classified damage (personal injury) into three classes: (Kahler & Ellis, 2002, pp. 1-2)

1) Class 1 – Permanent damage to an individual which results in any permanent physical or psychological impairment. Class 1 also includes fatalities.
2) Class 2 – Temporary damage to the body such as fractures, sprains and lacerations requiring sutures. Persons suffering Class 2 damage are expected to recover.
3) Class 3 – Minor damage presents no more than an inconvenience in the form of minor cuts and abrasions etc. Class 3 damage causes discomfort but the injured is capable of performing normal duties.

Kahler & Ellis, 2002, classified *damage type* into three types: (Kahler & Ellis, 2002, pp. 5)

1) Type A Damage – Defined as a single, traumatic energy exchange such as an electric shock.
2) Type B Damage – Defined as a series of energy exchanges resulting in cumulative damage such as lifting pushing, pulling leading to back problems.
3) Type C Damage – Defined as continuous small energy exchanges resulting in cumulative damage such as prolonged exposure to noise or chemicals.

While Kahler & Ellis, 2002, described an apparently useful method of classifying severity in terms of damage class and damage type, they did not include any reference to injury across age groups nor did their classification system appear to correlate with body part effected. However their classification may provide a useful analytical component for assessing severity (damage class) and energy exchange involved which will be deemed to be synonymous with “agency involved”.

If we accept that all accidents involve an exchange of energy (Kahler & Ellis, 2002, pp. 4), then it may be feasible and useful to classify accident in terms of this parameter. It may also be reasonable to investigate possible correlations to other selected parameters. For example, the energy exchange involved in a fall could be described as gravity and so it may be reasonable to suspect falls (gravity) to correlate with slips and trips. While these definitions appear to be useful in linking energy sources to the type of tasks workers may be performing, there is no apparent link between energy source and age groups.

Energy exchanges according to Kahler and Ellis. (Kahler & Ellis, 2002, pp. 4).

1) Machine Energy – Any machine in operation fixed or portable.
2) Thermal Energy – Extremes of temperature.
3) Electrical Energy – Contact with a source of electricity.
4) Vibration Energy – Continuous vibration over a period of time.
5) Radiation Energy – Exposure to ionising and non-ionising radiation.
6) Gravitational Energy – Any object or person falling.
7) Noise Energy – Exposure to noise sources of varying intensity and duration.
8) Susceptible Part – Low level energy exchange to sensitive body parts
9) Specialised Shape – contact with sharp pointed objects.
10) Vehicular Energy – Vehicle collisions, struck persons, vibration, jolting and jarring.
11) Human Energy – Physical muscular exertion
12) Chemical Energy – Damage to the body due to contact with chemicals via any method of ingress.
13) Biological – Bites Infections as a result of contact with a biological source.
14) Object Energy – Struck by an object other than a falling object.

Breslin et al found that musculoskeletal injuries across age groups were an important finding in their study with sprains and strains being the leading cause of injury across all age groups. They suggested that musculoskeletal injuries, especially to the back may increase the likelihood of further injuries and may be a useful predictor of future back injuries (Breslin et al., 2003, pp. 3). This raises the possibility of injuries suffered early on in life having the potential to impact future statistics due to long term effects.

Youth, inexperience, lack of supervision and training are not the only factors identified as contributors to industrial accidents. However other identified contributors appear not only to affect the younger groups but also appear to status the older age groups as well. Shift work and fatigue have been identified as a source of concern and possible contributors to accidents. Fatigue may affect a workers level of fitness for work, potentially rendering them more susceptible to having an accident than other, fit workers. Potentially, younger workers may be more at risk from such apparently less obvious hazards due to lack of awareness of these issues.

Haworth identified fatigue as a factor in road accidents and defined it as a deterioration of alertness and physiological well being leading to lapses and misjudgement of situations (Haworth, 1998, pp. 1-2). She identified sleep patterns and hours at work (in this case driving hours) as key contributors to fatigue and concluded that drivers should be educated to recognise the onset of fatigue and take appropriate measures (rest and/or meal breaks) when these symptoms become evident (Haworth, 1998, pp. 3-5). It would not be unreasonable to apply these findings to the workplace scenario where shift work is required. Baker et al also concluded that fatigue was a state of physical and/or mental impairment, usually associated with sleep deprivation but further linked it to the body's natural circadian rhythms (Baker & Ferguson, 2004, pp. 5). The report focussed on several fatigue contributory elements including shift length, overtime on-call work, commuting issues and starting times (Baker & Ferguson, 2004, pp. 11-21). The report also included a recommended management plan to appropriately deal with shift work related fatigue issues (Baker & Ferguson, 2004, pp. 31-32).

Reporting of accidents and near misses has been enforced by some mining companies for several years now. Dampier Salt Limited requires 100 percent reporting of all occurrences with the aim of identifying unrecognised hazards, correcting the problem, disseminating information across all four sites to prevent a reoccurrence. It is perceived that correct reporting has the potential to reduce accidents by the progressive identification of unrecognised and new hazards. If new starters to the workforce embrace this culture upon entry, the potential for this concept to be fostered and become a normal component of their work ethic may be enhanced. Even so, there are legislative requirements for the reporting of electric shocks, bone fracture and fires as detailed by the Department of Minerals and Energy (Mines Occupational Safety and Health Advisory Board, 2001, pp. 2-3).

A search of the literature found limited material on secondary school curricula coverage of safety in the work place. Though it appears the subject is being covered to an undetermined extent in some schools. A work experience guide for employers has been produced outlining several areas of importance before they accept a work experience student (Education Line, 2003). Worksafe Western Australia is involved in secondary school courses specific to occupational health and safety and is committed to increasing student numbers in their discipline.

Their structured learning programs appear to be focussed on issues relevant to safety in the workplace (Worksafe Western Australia, January, 2002, pp. 46). While it may be evident that secondary schools are providing some training in workplace safety, evidence could not be located to attest to what degree. Nor could reference be found as to the effectiveness of any program currently in place.

2.2 Summary:

As a result of the literature review, several key issues emerged which feature as denominators in the four accident constructs.

1) Workplace Contributing Denominators
2) Workplace Mitigating Denominators
3) Personal Contributing Denominators
4) Personal Mitigating Denominators

Key issues were selected due to their potential relevance to answering the research questions regarding accident denominators across age groups from the selected populations. The emergent issues appear to be relevant to all age groups but some appear to have a higher potential regarding accidents among young, inexperienced workers. Issues pertinent to this group appear to be training, experience, supervision, gender, task performed, industry type, compliance with legislative and company requirements and lack of secondary school training. The four accident constructs were designed to attempt to answer each of the research questions.

3.0 THEORETICAL FRAMEWORK

3.1 Purpose:

The theoretical framework for this study was not intended to be an accident causation model. It does not purport to identify all causal factors leading up to an accident. Nor to define causative agents in terms of primary and secondary causes unsafe acts or unsafe conditions. The theoretical framework of this research intends to:

1) Identify significant contributing and mitigating denominators which input to accidents, relevant to answering the research questions.
2) Design an instrument for the collection of data pertinent to contributing and mitigating denominators.
3) Supply information in terms of accident outputs for each of the age groups.
4) Make recommendations aimed at augmenting current safety managements systems.

A search of the literature was unable to locate a model or design capable of collecting data specific to these requirements. Therefore the described theoretical structure was used.

3.2 Structure:

Key issues emerging from the literature review were identified as denominators used for the development of the four accident constructs:

1) Workplace Contributing Denominators (WCD)
2) Workplace Mitigating Denominators (WMD)
3) Personal Contributing Denominators (PCD)
4) Personal Mitigating Denominators (PMD)

(Denominator status is fully described in the *Data Analysis* section on pp 31 of this report.)

Two accident constructs are comprised of contributing denominators and two accident constructs are comprised of mitigating denominators. Contributing denominators can be demonstrated to exhibit a definite contributory impact toward an accident, mitigating denominators, being subjective by nature are assessed on their potential to prevent an accident or mitigate the effects (output) arising from an accident.

For example, a trained worker can still be involved in an accident but the potential effect of training or lack of, may have contributed to or mitigated the potential output of that accident. Denominators are further subdivided into *workplace* and *personal* denominators. It is theorized that **workplace denominators** come under the control of the company's safety management system and may impact workers physically and mentally. Potentially impacting trust in management, morale, accident frequency rates etc. That is, physical workplace conditions can potentially affect both the physical and mental aspects of workers safety. It is also theorized that **personal denominators** do not directly come under the control of the company's safety management system; though personal denominators may potentially be influenced by company efforts in efforts to gain worker trust, effecting culture change etc. Personal denominators are characteristics of the individual workers physical, mental and moral make up. It is the individual who chooses to deliberately violate a rule or is too timid to ask for guidance. Personal denominators, like workplace denominators also impact the company's accident profile but additionally, they can potentially assist management in identifying focal characteristics and values present in the group dynamics of their work force. These foci may be of value in affecting culture changes and the development of *core values* for their safety regimen. The dynamics of workplace and personal denominators requires further research as outlined in section 6.4 of this report pp 84. Strategies designed to deal with personal denominators are outside the scope of this report, other than an attempt to identify their presence.

Denominators can impact a single accident, where they potentially have an active effect or they do not. In such cases they are considered to be *dichotomous denominators,* as defined on pp 6. A worker was either working outside their skill level or they were not. However, when considering group dynamics, in any given age group, the same denominator can be demonstrated to have been a contributor in some instances and a mitigator in others. When a denominator displays this dual character, with regards to groups, it is deemed to be a *composite denominator,* as defined on pp 5.

The identification of significant active denominators may potentially be useful in augmenting current safety management strategies by defining corrective and preventative foci.

A **significant denominator** is any denominator that scored a frequency of 40% or more, as defined on pp 7. Only significant denominators will be considered for the purpose of this report.

This concept applies equally to contributing, as defined on pp 5 and mitigating denominators, as defined on pp 6 Contributors are considered to be *trailing indicators* as defined on pp 7, becoming evident after the accident has occurred. Trailing denominators are useful in correcting unsafe conditions and acts to prevent a re-occurrence. However, mitigating denominators can be considered as *leading indicators, as* defined on pp 6, as they potentially act in a subjective, preventative manner. Mitigating denominators are essentially “what people and systems are doing right”. It is theorized that the positive indicators are not fully utilised in industry and important benefits of these preventative foci potentially missed and requires further research as outlined in section 6.4 of this report pp 84.

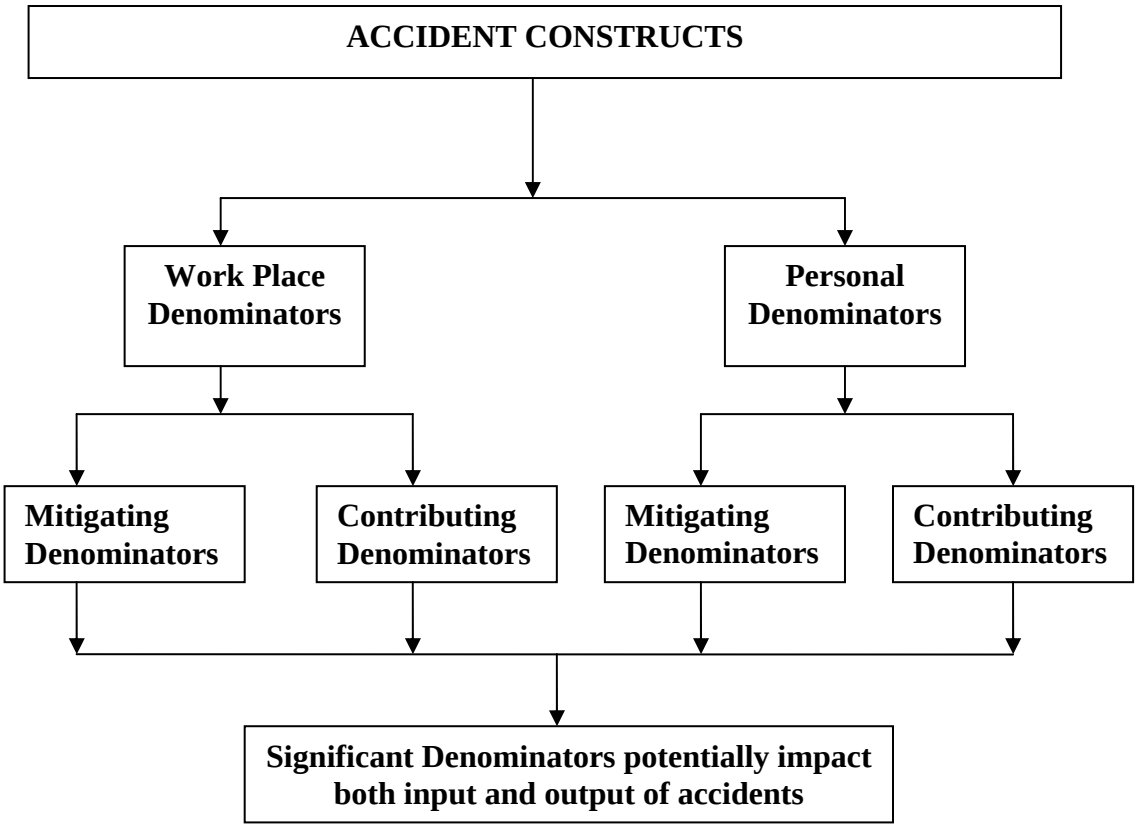

Figure 3.2.1 Accident Construct Denominators

Examples of Accident Constructs:

Table 3.2.1 The Four Accident Constructs.

Workplace Contributing Denominators **(WCD)**	Workplace Mitigating Denominators **(WMD)**	Personal Contributing Denominators **(PCD)**	Personal Mitigating Denominators **(PMD)**
Lack of work experience	Pre-Work experience	Lack of confidence	Works within competency levels
Lack of training	Adequate training	Over confident	Works within scope of training
Inadequate refresher training	Refresher training provided	Complacency	Keeps mind on the job
Inadequate supervision	Adequate supervision	Willing to violate	Adheres to rules
External pressures affect safety performance	No external pressures	Willing to take short cuts	Not prepared to take chances
Internal pressures affect safety performance	No internal pressures	Incorrect peer training	Prepared to challenge information provided by peers
Induction process too general	Adequate induction	Previous bad habits from previous experiences	Has had no previous work experience
Hazard ID skills poor	Hazard ID skills well developed	Fear of peers	No fear of peers
Nor familiar with safety management system	Conversant with Safety management system	Fear of job loss	Trusts management with regards to job security
Not enough time	Ample time	Need to impress	No need to impress
Task above skill level	Trained to appropriate skill level	Job above skill level	Trained to required skill level
Unable to cope with shift roster	Copes with shift roster	Lack of understanding of legislative requirements	Understands legislative requirements
Hours too long	Copes with length of shift	Personal low morale	Contented with job
Conflict with private life	No conflict with private life	Perceived low morale of peers	Generally workers appear content
No reporting training	Prepared to report incidents	Fatigued	Always fresh for work

Table 3.2.1 lists the denominators comprising the four accident constructs derived from the literature review. The four constructs consist of Workplace Contributing Denominators (WCD), Workplace Mitigating Denominators (WMD), Personal Contributing Denominators (PCD), Personal Mitigating Denominators (PMD). The combination of these constructs result in denominators, as selected from the literature review, as significant for this research as described in Figure 3.2.1 on pp 21.

Application of Accident Constructs to Age Groups:

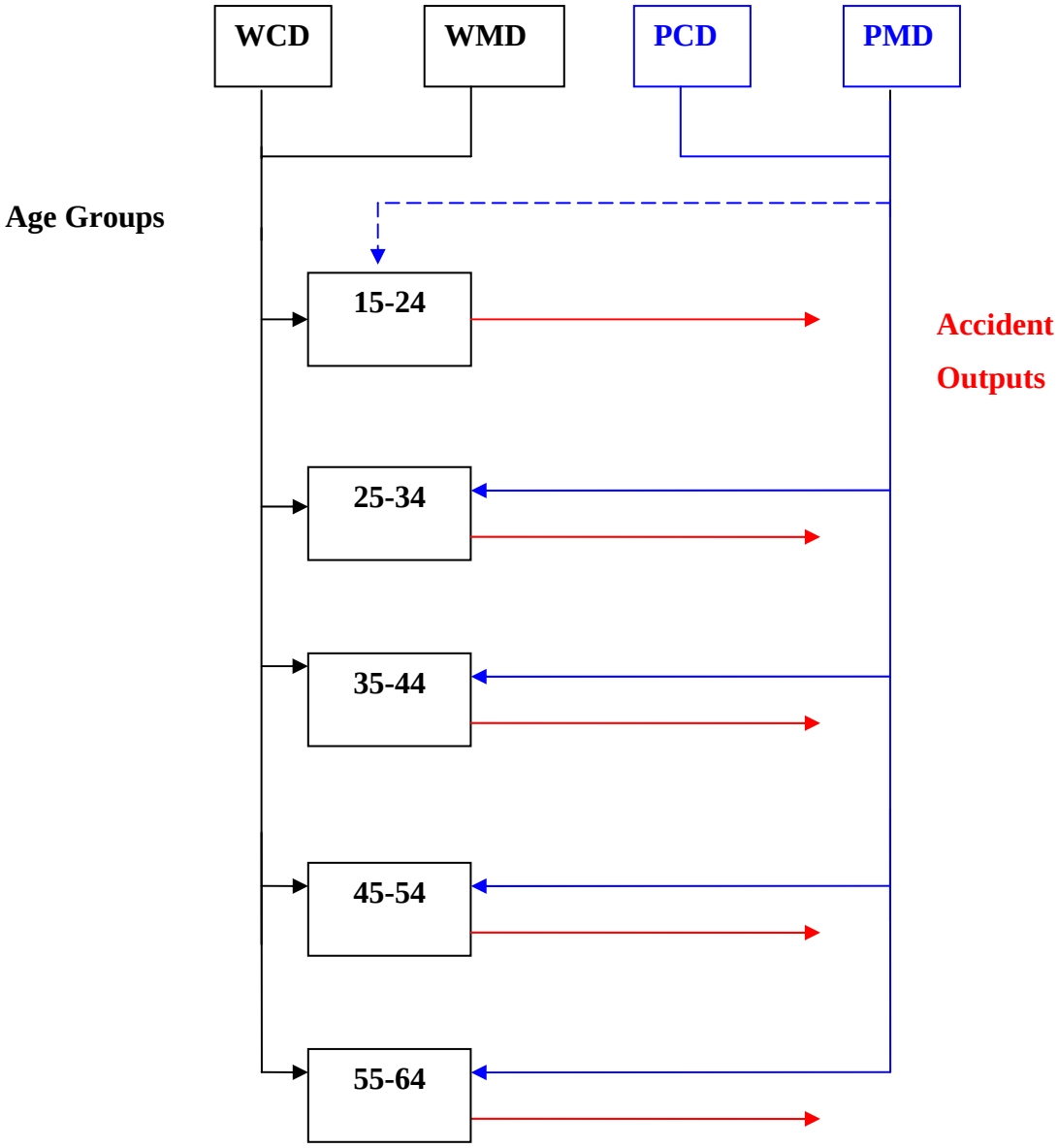

Figure 3.2.2 Application of Accident Constructs to Age groups

Figure 3.2.2 describes the impact of denominators comprising the four accident constructs Workplace Contributing Denominators (WCD), Workplace Mitigating Denominators (WMD), Personal Contributing Denominators (PCD), and Personal Mitigating Denominators (PMD). Workplace derived denominators have to potential to impact any age group and are under the control of a companies safety management system.

The effects of personal denominators are not directly under the control of the company's safety management system and potentially impact safety performance via a different pathway.

Personal denominators may have the potential to exhibit particular impact on the youngest age group due to lack of knowledge and experience or pre-conceived ideas from pre-work experiences.

Contributing and mitigating denominators potentially impact any age group, thereby influencing the accident characteristics of these groups. This has been shown to be especially significant among the younger age group, where lack of supervision, training and inexperience appeared to feature as significant contributors. The literature review did not reveal the potential role that mitigating denominators might play in supplementing an existing safety management system. These constructs are designed to identify denominators associated with accidents whether they contributed to, mitigated from or were passive with regards to a particular accident. Denominators of interest being:

1) Training
2) Supervision
3) Experience
4) Gender
5) Task performed
6) Industry type
7) Compliance with rules
8) Lack of secondary school training

Potentially denominators arising from the effects of *PCD* and *PMD* factors on accident outputs is may stabilise or destabilise established accident rates, on any age group, to induce the use of acceptable safe work practices or conversely, the use of unsafe work practices. That is, they could act to either increase, decrease or stabilise an existing statistic. Therefore they do not input into each age group via the same path *WCD* and *WMD* and their effect may not be detectable at all if accidents rates remain stable in experienced age groups. If there is a measurable resurgence of accidents in older experienced groups, yes it is possible that it could be associated with an active personal contributing denominator. For example, complacency or misjudged confidence levels could be potentially higher in experienced groups. However, this does not rule out that the resurgence did not arise from an active workplace denominator or a combination of both.

The effects arising from the action of personal and contributing denominators upon age groups requires further research as outlined in section 6.4 of this report pp 84.

Potentially not all denominators comprising these constructs will be relevant to young workers just entering the workforce, as accident dynamics for this group may not yet have been established and some denominators may be irrelevant until this group have become experienced. For example, it is unlikely that inexperienced workers would have similar personal profiles to older, experienced groups. However, it should not be entirely ruled out that in some cases these two factors may well be applicable to new starters entering the workforce for the first time. Or even a new starter to a particular industry with no experience in that industry, belonging to any age group. This is suspected for two reasons. Firstly; some new starters may be entering the workforce with skills, experiences and practices, which may or may not be appropriate, already established. They simply *carry baggage* having brought with them pre-developed personal profile. For example, rural youth may well have useful skills such as welding and manual handling expertise that their city, residential counterparts do not. Thereby potentially entering the workforce with pre-conceived ideals regarding safe work practice that may or may not be acceptable to industry, Secondly; the theoretical framework of this study did not attempt to account for individual personal traits of young people. The blue dotted line entered into the theoretical framework block diagram describes a pathway whereby pre-conceived ideals and past practices, in the form of personal contributing and mitigating denominators may enter into the safety performance dynamics of the youngest work group. However, these same denominators can also impact on any age group to potentially strengthen or de-stabilize safe working practices of any age group.

Once an accident occurs, the results can be expressed in terms of *accident output*. It is important to capture the accident out profile of each age group as output is potentially an artefact of input denominators. Therefore it would be reasonable to expect accident outputs to also display age group characteristics.

For the purpose of this study accident outputs have been defined as:

1) Energy Exchange Involved
2) Body Part Affected
3) Severity of Injury (Damage class)
4) Damage Type
5) Industry Type

However, it is recognised those actions arising from accident output data are *trailing indicators* and that trailing indicators may also be useful in identifying active leading indicator denominators; such as training to improve hazard identification where failing to identify a hazard was an active contributing denominator.

Potentially fluctuations may occur across older age groups in terms of accident output due to the potential of complacency affecting the actions of older workers who are now confident in what they do. Concurrently, it is also theorized that skills that are performed often become *core values* of that workers skills set and as such become may become mentally automated potentially freeing their brain for other activities as they work. This potentially could impact their hazard identification process if conditions around them changed to introduce new hazards, which go unnoticed.

Age Group Accident Outputs:

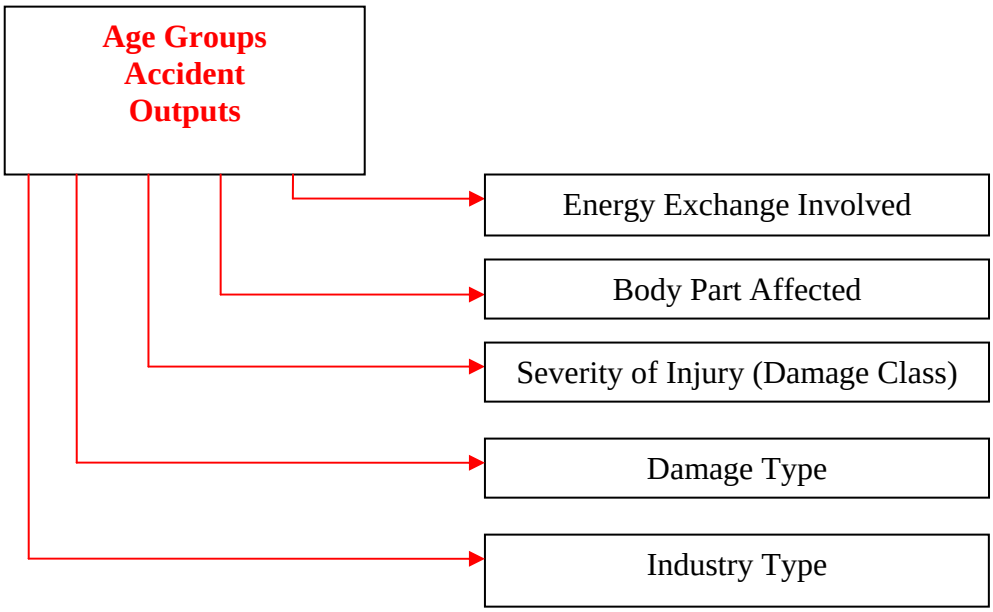

Figure 3.2.3 Age Group Accident Outputs

Summary:

The reasoning underlying the application of the four constructs is that young people appear to be suffering higher accident rates than older work groups (as established in the literature review). Also, these four constructs successfully identify key denominators in terms of input characteristics, expressed as *contributors* or *mitigators*. These contributors and mitigators can be workplace or personal in nature and that personal denominators effect group accident dynamics differently than work place denominators.

Once an accident has occurred, its effects can be assessed by describing the accident output in terms of defined criteria. This method has been incorporated to accurately describe the effects of accident data collected for this research.

4.0 METHODOLOGY

4.1 Study Design:

A search of the literature was unable to locate an existing study design capable of answering the research questions in terms of accident inputs and outputs, as described in the theoretical framework; therefore the following design was developed.

4.2 Basic Concepts:

This is a descriptive study of an industrial population to assess selected attributes as described in the theoretical framework.

Data was collected from this population by random sampling to determine if trends exist between accident input and output criteria across the defined age groups. Data was collected from selected industries. This information was then used to address each of the research questions, make comparisons with literature review findings, draw conclusions and make recommendations to participating industries regarding improving current safety management systems.

The described accident constructs were used to develop instruments for data collection where a pilot study was performed to identify weak questions. The main body of data was then collected from randomly selected industries in the Port Hedland region.

4.3 Target Population:

Empirical data from a randomly selected sample of the target population, comprising industrial personnel of the Port Hedland region was collected and used to evaluate the research questions. The sample consisted of representative workers in mining and heavy industry of Port Hedland who have experienced work related injuries since the year 2000. To ensure these parameters were met, only mining and associated processing and construction industries were considered.

4.4 Selection of age Groups:

Selection of age group dimensions was based on the distribution of accidents identified by Rix (Rix, 2001, p. 7). Rix's figures for each age group were expressed as a percentage and were not linked to person years; therefore scores may be potentially confounded by different sized age groups. For this study 30 participants represented each age group and as accident rates were not being sought, person years were not required. Determination of accident denominators relative to the number of accidents per age group is the primary focus of this report and as the numbers of accident per age group are equal, Rix's grouping appears satisfactory.

4.5 Sampling Plan:

A questionnaire was used to collect accident information relevant to input denominators and accident outputs. Potential industries within Port Hedland were selected by a random number selection from a list of potential industries. Individuals from each industry were addressed as groups, on their work site and after an explanation of what were required, the questionnaires were handed out. The groups were comprised of workers from each industry and the meeting was pre-arranged. The questionnaires were completed and collected at the point of issue, at the one meeting. This method presented the opportunity for participants to clarify any misunderstanding prior to answering questions. It also offered the potential to minimise missing information. Information collected from this sample was used to analyse and assess input/output criteria.

4.6 Selection of Participants

Volunteer workers were called for from the selected industries and an on-site meeting arranged, as described in the Sampling Plan. All completed questionnaires were arranged into age groups as per section 4.4 of this report and thirty randomly selected from each age group.

4.7 Instrument Development:

Questionaries were developed to align with the following criteria:

1) Accident input data as denominators defined by the accident construct table as identified by the literature review.
2) Accident output data as identified by the literature review.

A pilot study was conducted to identify weak questions.

4.8 Data Collection:

When addressing the selected groups emphasis was placed on the following criteria:

1) Confidentiality.
2) Ownership of data.
3) Intended use of data.
4) Forbidden use of data.
5) Destruction of data.
6) The right of the participants to withdraw at any time.
7) The right of participants to review material before final submission.
8) The right of participants to make further contact and question.

Personnel under the age of 18 required parental or guardian consent prior to participating.

A sample was tested for reliability by measuring its Cronbach's alpha to identify weak questions. The collection instruments were then used to collect the main body of data without the removal of any questions due to the overall Cronbach's alpha score of 0.843. All data was coded and entered into an SPSS spreadsheet for statistical analysis.

4.9 Data Analysis:

Data was analysed to identify significant active denominators contributing to an accident or displaying a mitigating effect by analysing the frequency for each denominator split by age groups.

Each question in the questionnaire represented an accident denominator of interest. These denominators were identified from the literature review. All questions were asked in the positive mode on a Likert scale, where scores of 1 and 2 indicated subjects *strongly disagreed or disagreed* (summated) that this denominator was inadequately controlled, thereby contributing to their accident. That is, ***strongly disagree + disagree = contributing.*** Conversely, if the subject *strongly agreed* or *agreed* (summated) that a particular denominator was adequately controlled, it was considered not to have contributed but potentially mitigated. That is, ***strongly agree + agree = mitigating***. For example; "You were adequately trained for this task", the subjects believed they were either adequately trained or they were not.

If they had not been trained, then this denominator was assigned the active status of a contributor. If they had been adequately trained to perform the task in which they were injured, then the subjective point of view that the training potentially had a mitigating effect is accepted and the denominator consequently assigned the active status of mitigator. Potentially other denominators may have contributed to that particular accident.

Where a group was *unsure* whether a denominator contributed or not, it was simply scored it as *unsure*. Unsure scores cannot be simply ignored. The greater the score for unsure, the less likely a group will recognise the presence of a particular denominator and be unable to utilise it to its full potential be it a contributor or a mitigator. Therefore large scores for unsure may tend to indicate composite denominators as they could act unwittingly either way. A large score for *unsure* does not affect denominator *significance*.

This method permitted denominators to be identified as *active* or *passive* and if active whether they were *contributing* or *mitigating*. Denominator status was assigned with reference to age groups and not to individuals. This was achieved by examining frequencies of split field data split across the age groups.

The frequencies of denominator status were presented as histograms for the purpose of this analysis and assignation of denominator status. Frequency results indicated that a particular denominator could affect an age group both as a contributor and a mitigator concurrently. Where this group property was identified, the denominator was deemed to be composite in character.

The sample also supplied data pertaining to accident outputs with the aim of identifying output trends with respect to age groups. This data was also analysed for frequencies split across the age groups to determine if outputs from accident displayed trends with respect to age groups.

4.10 Pilot Study:

A pilot study was conducted on the first 20 questionnaires to test for reliability by determining the Cronbach's alpha. This was performed on the first twenty completed questionnaires received in each case. The group Cronbach's alpha of 0.843 was returned on a test run on the first 20 questionnaires received. All questions were retained. The main body of data was then collected

Table 5.1 Cronbach's Alpha Scores for Construct Data

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
.843	.852

A Cronbach's alpha is a estimator of reliability and is used to identify weak questions in a questionnaire. That is, questions that if given to a similar test group would produce a similar result. A Cronbach's alpha score of 0.8 or more for a given question is considered to be acceptable. A score of 0.843 for the construct data questionnaire suggested the instrument could be used to collect the remaining data.

5.0 RESULTS AND DISCUSSION

5.1 Accident Construct Research Results:

Denominator inputs into accidents had initially been envisaged to be either *active* or *passive*. An active denominator could either contribute to or mitigate from an accident. A passive denominator was considered to display zero status. Denominators were not initially envisaged to act as both simultaneously. This has proven to be the case when considering individual accidents; however this is not the case with regards to age group dynamics. Single denominators can impact a group, displaying both properties simultaneously. Therefore they must be classified as composite denominators when operating in the group dynamics domain. Accident denominators can display a dichotomous or composite character, depending upon which domain they are operating in.

Each of the denominators was assessed regarding their status on each age group. Each denominator was presented in the positive mode when collecting data and respective status assigned accordingly. The sum of *strongly agree* and *agree* scores were defined as **mitigating** denominators, likewise the sum of *strongly disagree* and *disagree* were defined as **contributors** as described in section 4.9, pp 31 of this report.

It is important to identify mitigating and contributing denominators as a dual focus can be applied to the safety effort and company safety expenditure. A strong focus on contributing denominators has the potential to channel effort toward correcting contributing denominators. Such denominators are often *lagging indicators*, raising awareness, *after* the event. Mitigating denominators, on the other hand, potentially identify the positives; the things that are being done correctly to prevent injuries. Such denominators are *leading indicators*, and if identified and recorded, are potentially useful in fostering the positives. It is theorized that a safety management system focusing entirely on negative issues is potentially devoid of a mechanism for achieving a culture change towards a dynamic and sustainable safety system. And that it is equally important to apply focus to the positives.

Individual age groups were measured against each denominator to determine on which age group each denominator had maximum and minimum status.

The frequency for each age group score, for each denominator was expressed as a histogram. Individual age group trend graphs have been evaluated and individual age group comments made where applicable. Where trending is obvious, only the age group summary is provided.

5.1.1 Age Group Denominator Analysis:

Table 5.1.1 Accident Denominator Status

Denominator	**Status by Frequency**	**Denominator**	**Status by Frequency**
Supervision Required	Composite	Cope with Roster	Mitigator
Supervision Adequate	Passive	Length of Shift	Composite
Trained for Task	Mitigator	Private Life Conflict	Composite
Refresher Training	Contributor	Internal Pressure	Composite
Peer Training Only	Passive	Confident	Mitigator
Induction Too General	Composite	Work Within Skills	Composite
Hazard ID and Control Training	Mitigator	Complacent	Composite
Company Safety System Training	Composite	Will Not Violate	Composite
Very Experienced in this Task	Composite	Will Not Take Short Cuts	Composite
Performed task Regularly	Composite	Not Afraid of Peers	Composite
Ample Time	Composite	Fear of Job Loss	Composite
Legal requirements	Passive	Impress Management	Composite
Complied	Mitigator	Morale High	Mitigator
Company Requirements	Mitigator	Ignore Peer Safety Breeches	Composite
Complied	Mitigator	Healthy Lifestyle	Composite
External Pressure	Composite	Trust in Management	Composite
Fit For Work	Mitigator		

Table 5.1.1 summarizes the status assigned to each denominator after data analysis, as indicated in Figures 5.1.1 to 5.1.33 on pp 36 – 70. Denominators were classified as being either a contributor, mitigator, or as passive, displaying no discernable effect, or composite, with the potential to act as both a contributor and a mitigator.

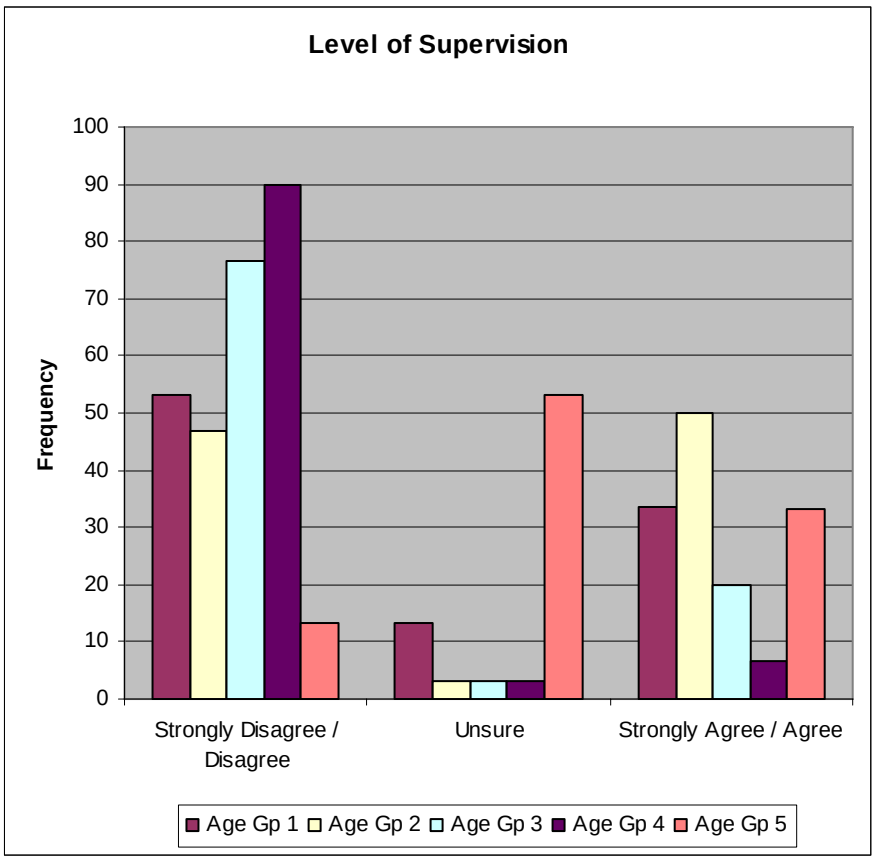

Figure 5.1.1 Supervision Required

Age Group Summary:

Denominator Status: *Composite*

Many of the workers indicated they required some level of supervision for the particular task in which they were injured, which was not provided, thereby contributing to their accident. Over 50 % of age group 1 indicated such, which appears reasonable. In particular, the older groups indicated they required some level of supervision, with the exception of age group 5. All groups were certain they required supervision with only age group 5, again, displaying the opposite trend. It is unclear why age group 5 is so unsure. It is theorized, perhaps they consider themselves accomplished in their role and supervision may have negligible safety advantage for them. Supervision levels and methods still require further research as outlined in section 6.4 of this report pp 84.

However, from all age groups were in agreement that a level of supervision was required and this denominator did not contribute to their accident. The frequency score for unsure is low, therefore this denominator is assigned the status of composite.

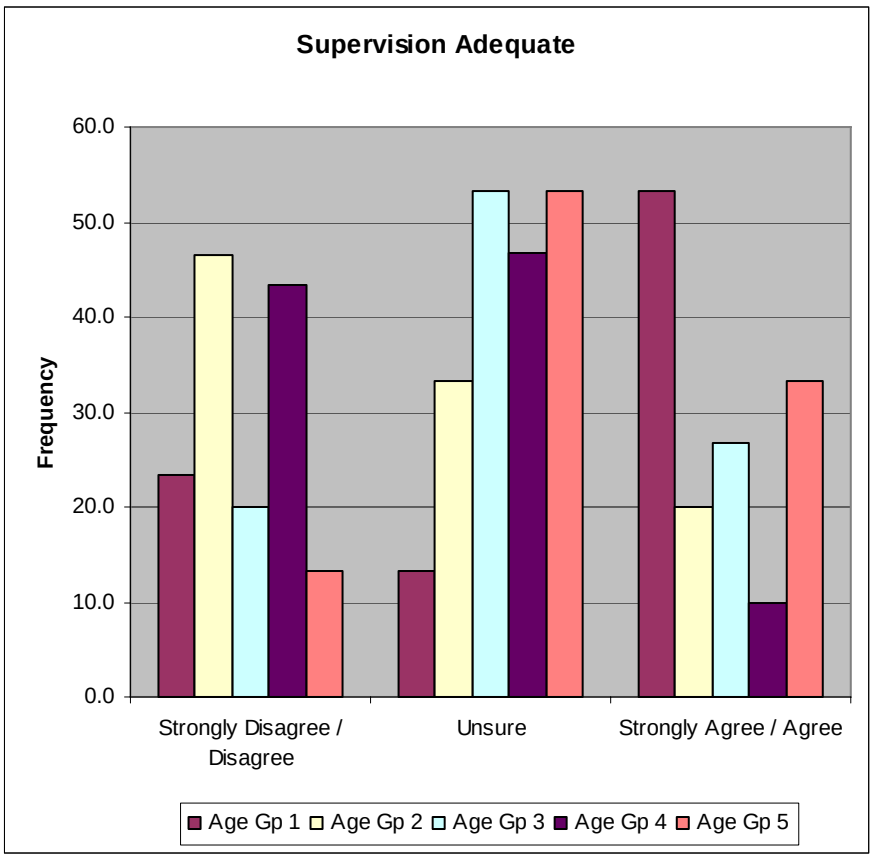

Figure 5.1.2 Supervision Adequate

Age Group Summary:

Denominator Status: *Passive*

The composite nature of this denominator indicates that supervision is a significant contributor to accidents across all age groups. The fact that this denominator does not trend down with older age groups is suggestive of potential supervisory issues within specific industries.

Age group one indicated they were generally satisfied with the level of supervision. This would be expected as new comers to the work place should receive initial training, and supervision. Overall, supervision appears to act as a mitigating denominator in some instances; however, it is evident that poor supervision still contributes to some injuries. Age group 2 indicates 46.6% believe inadequate supervision contributed to their accident. It is theorized that supervision levels may be decreasing as this group is now deemed to be experienced. The remaining groups display both mitigating and contributing denominators. Group 4 indicated resurgence for supervision as a contributor and an attenuation of the mitigating denominator.

Current data cannot explain this result. However, 46.6% were unsure; potentially indicating that supervision is not only a significant denominator but it is also poorly understood by the workers, with the older groups being the most unsure.

Individual perspective of what comprises adequate supervision may also differ from one individual to another. In this study there was no differentiation established between supervision types. For example, “within sight” supervision or occasional visits from supervisory personnel.

Supervision stands out as a significant composite denominator, which appearing to be poorly understood by many workers.

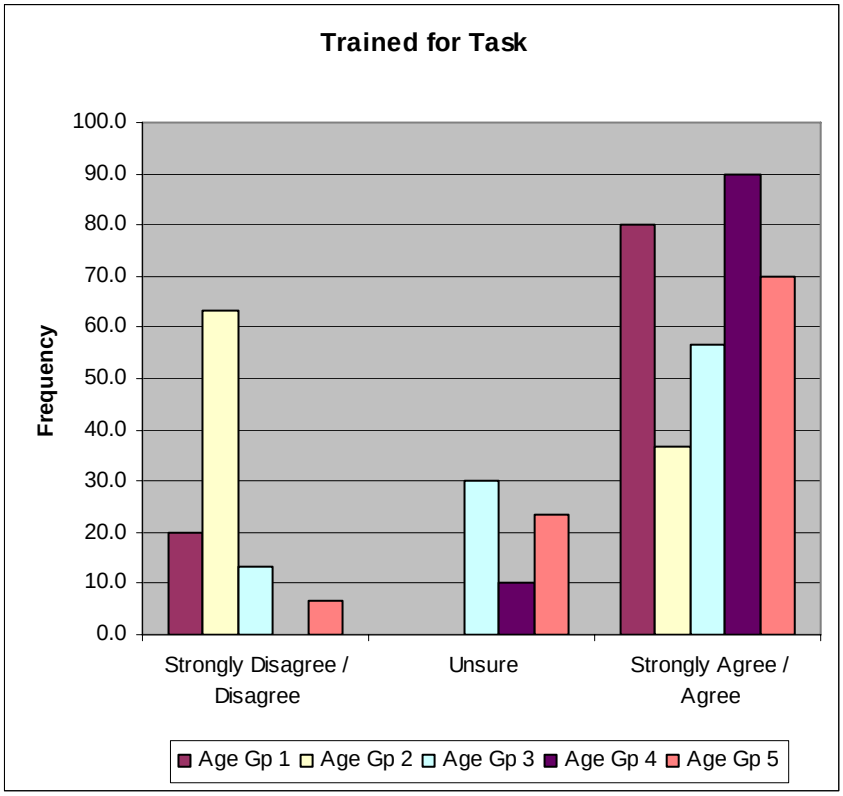

Figure 5.1.3 Trained for Task

Age Group Summary:

Denominator Status: *Mitigator*

All age groups displayed a strong mitigating denominator with regards to task training. That is, lack of training did not contribute to their accident.

However, there were still a minority who did consider lack of training contributed to their accident. This trend may be industry specific.

The exception is age group 2 who indicated lack of task training contributed to their accidents.

63.3% of accidents for age group 2 were contributed to by lack of training for the task. There was not enough data collected to elucidate further to explain this trend and it is theorized this group, being experienced in many tasks, may have been assigned to tasks for which they were not adequately trained and requires further research as outlined in section 6.4 of this report pp 84. Task training has emerged as a composite denominator having the potential to act as a strong mitigator.

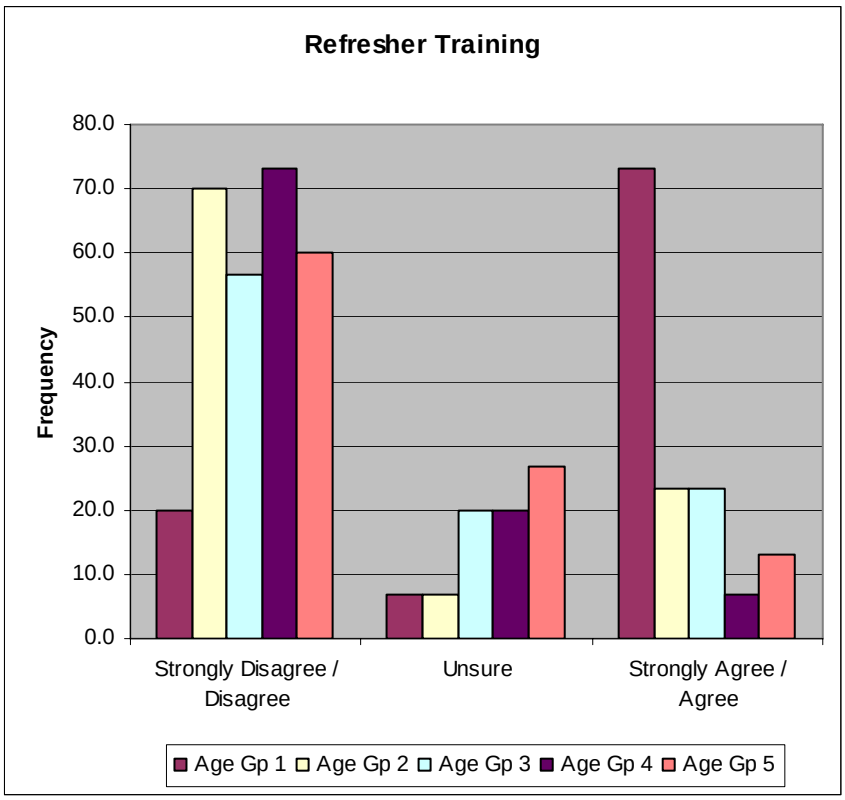

Figure 5.1.4 Refresher Training

Age Group Summary:

Denominator Status: *Composite*

Age group 1 appears to benefit from both initial and refresher training, given they are new to the workforce and potentially inexperienced, intensive training effort and adequate supervision would be expected.

Refresher training rapidly decreases as workers become older and are possibly deemed to be competent in all tasks they undertake. The potential for management to rely on this assumption when delegating tasks also appears to be realistic. Older workers benefit even less from refresher training than did younger groups; claiming lack of refresher training had contributed to their accidents. Once again a similar potential exists for assumptions to be made regarding their skill levels, given their length of time in the workforce. Older groups were also less sure about the need for refresher training, particularly with familiar tasks they performed frequently. Though, a majority claimed lack of refresher training did contribute to their accident.

Similar trend as for age group 4 however, members of this group are now approaching retirement age and the potential exists for a much reduced training effort, by management for these workers, based on potential financial return.

With exception of age group 1, refresher training appears to be poorly done, emerging as a strong contributor; especially as the older groups appear to be approaching retirement age. Given that the Australian workforce is aging and will continue to do so for some time to come; this contributing denominator is of some significance

The older the groups appear less sure regarding refresher training than the youngest two groups. Potentially, older groups could either require less refresher training due to their levels of experience and expertise or conversely, require it to ensure minimum standards are not being lost over time. This denominator has emerged as a composite due to the strong frequency score across most age groups and a significant unsure score.

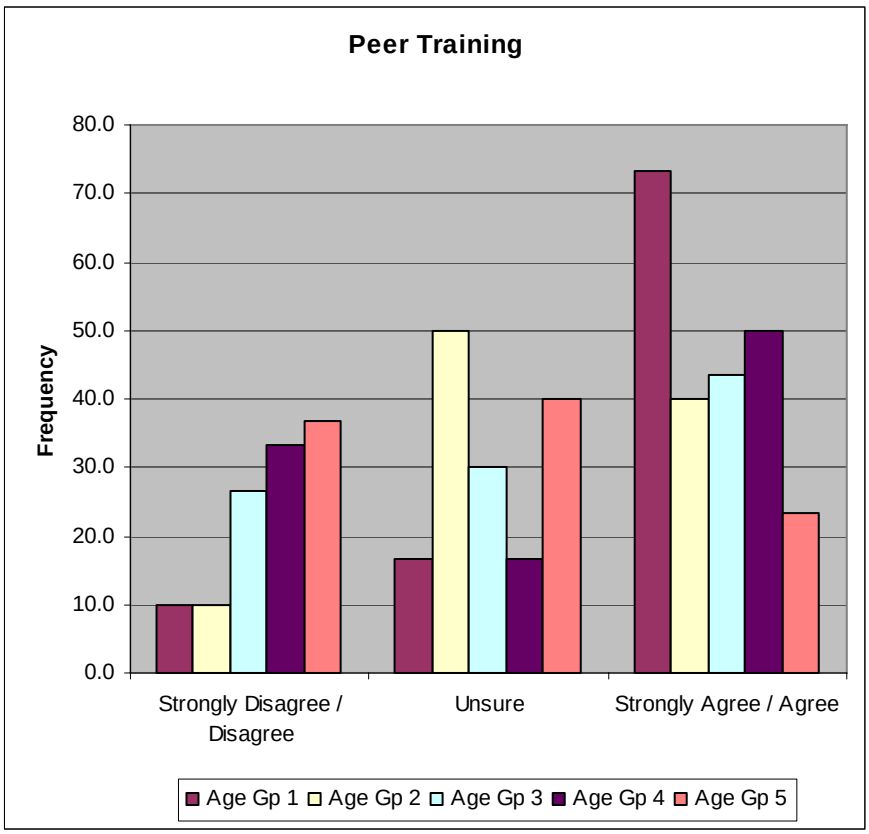

Figure 5.1.5 Peer Training Only

Age Group Summary:

Denominator Status: *Passive*

Younger groups indicated they did not primarily receive peer training, suggesting an adequate training effort by industry toward training new workers. The older the groups became, the more peer training (or potentially peer interaction) they received. This suggests that across industry, less training effort is being expended on the older workers. Across the age groups, from 16.7% to 40 % of workers were unsure. It is theorized they may be unsure of what is meant by peer training as opposed to other training and were consequently unable to associate it with their accident. The division between contributing and mitigating does not represent a polarization, due to the suspected lack of clarity as indicated by *unsure* scores. Therefore this denominator is assigned the status of passive. The dynamics and effects of peer training requires further research as outlined in section 6.4 of this report pp 84.

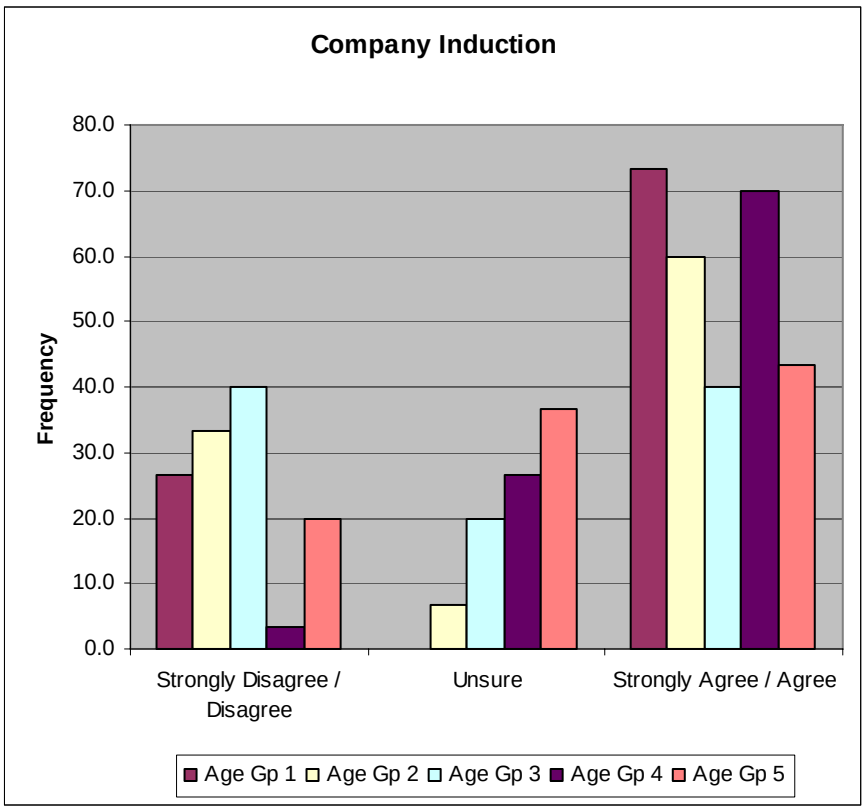

Figure 5.1.6 Company Induction.

Age Group Summary:

Denominator Status: Composite

Initially, this denominator appears to be composite in character with older workers strongly indicating the induction process is too general. Older workers also represent those who are unsure and are unable to indicate if poor induction exposed them to the hazard in which they received their injury. In particular, the youngest group were clear regarding induction effectiveness acted as a mitigator or a contributor. Because uncertainty appears to increase with the older groups it is theorized the induction process, partly due to generality, looses it's effectiveness as time progresses. This is potentially suggestive of a poor or lack of a refresher induction regime. This denominator impacts mainly as a composite. Company induction processes and consequent flow-on effects requires further research as outlined in section 6.4 of this report pp 84.

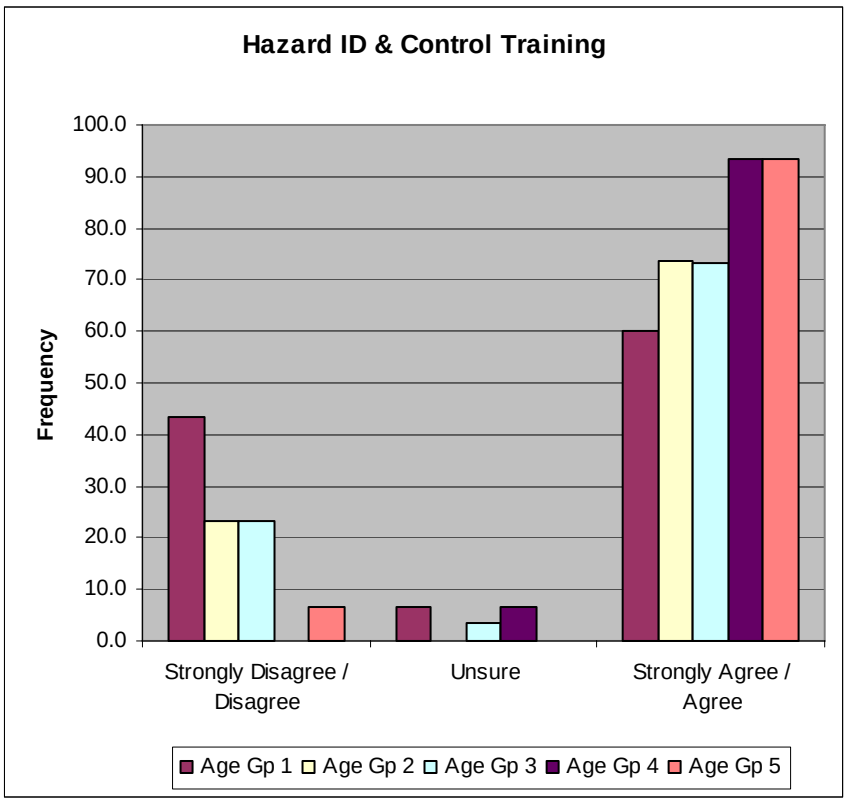

Figure 5.1.7 Hazard ID & Control Training

Age Group Summary:

Denominator Status: *Mitigator*

33.3% of age group 1 indicated lack of hazard identification training had contributed to their accident, whereby 60% were satisfied they had been adequately trained. It would be reasonable to assume younger and new workers would have a limited understanding of work place hazards around them, potentially failing to identify them and would most benefit from hazard identification training.

The question then arises as to why they did not identify the hazard responsible for their accident. It is theorized they were potentially undertaking unfamiliar tasks or working in unfamiliar areas and failed to recognize new hazards. This potential cannot be evaluated from the data collected. Older workers appear to be able to recognize hazards better than the younger workers. This trend appears reasonable given their respective experience levels.

All groups, with the exception of age group 1 appear very competent in this regard; emphasizing supervisory requirements for young and new workers.

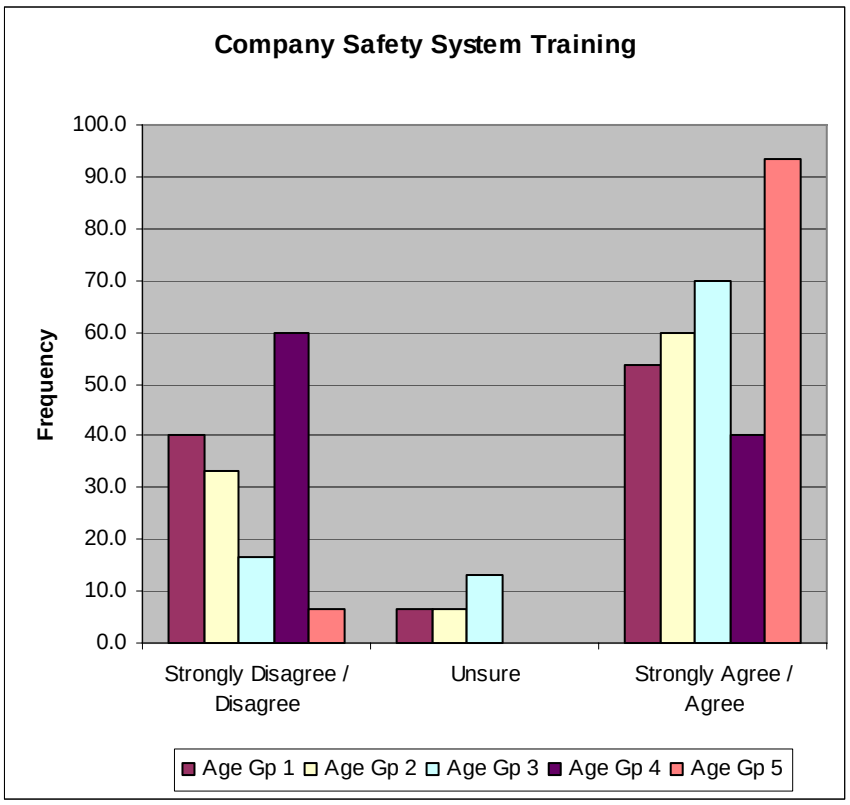

Figure 5.1.8 Company Safety System Training

Age Group Summary:

Denominator Status: *Composite*

It could be reasonable to suggest that all workers are exposed to the company's safety management system via their respective induction programs, therefore it could be theorized that training in the company's safety management system should be a strong mitigator. The effectiveness of training in company safety systems requires further research as outlined in section 6.4 of this report pp 84. The results clearly did not reflect this. The denominator emerged primarily as a mitigator also exerting a significant contributing influence. The reason for this finding is unclear and could be potentially industry specific or potentially linked to a lack of refresher training in this regard. Why age group 4 members consider this denominator contributed their accidents, while the other groups trended towards mitigation is also unclear.

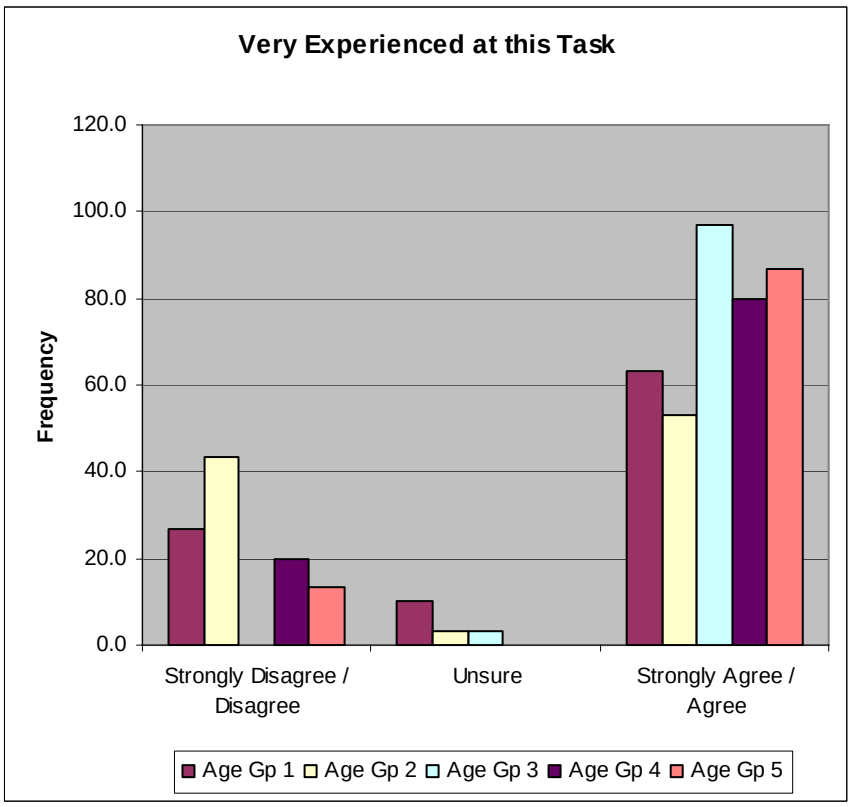

Figure 5.1.9 Very Experienced at this Task

Age Group Summary:

Denominator Status: *Composite*

Potentially experience in performing tasks mitigates towards accidents and that young and new workers, having less experience are more at risk than the older, more experienced workers. Results obtained reflect this concept. Although there were individuals in four age groups who claimed they were not experienced in performing the task in which they were injured. However, the majority of workers agreed they were injured in performing tasks in which they were familiar. It would be reasonable to ask if being experienced was really a mitigator after all. Why were such a large proportion of workers hurt on familiar tasks? It is theorized other agencies such as complacency may be involved. From the collected evidence this denominator appears difficult to assign a status accurately and could potentially benefit from further study; although the evidence suggests a potential to exert the dual influence of a composite.

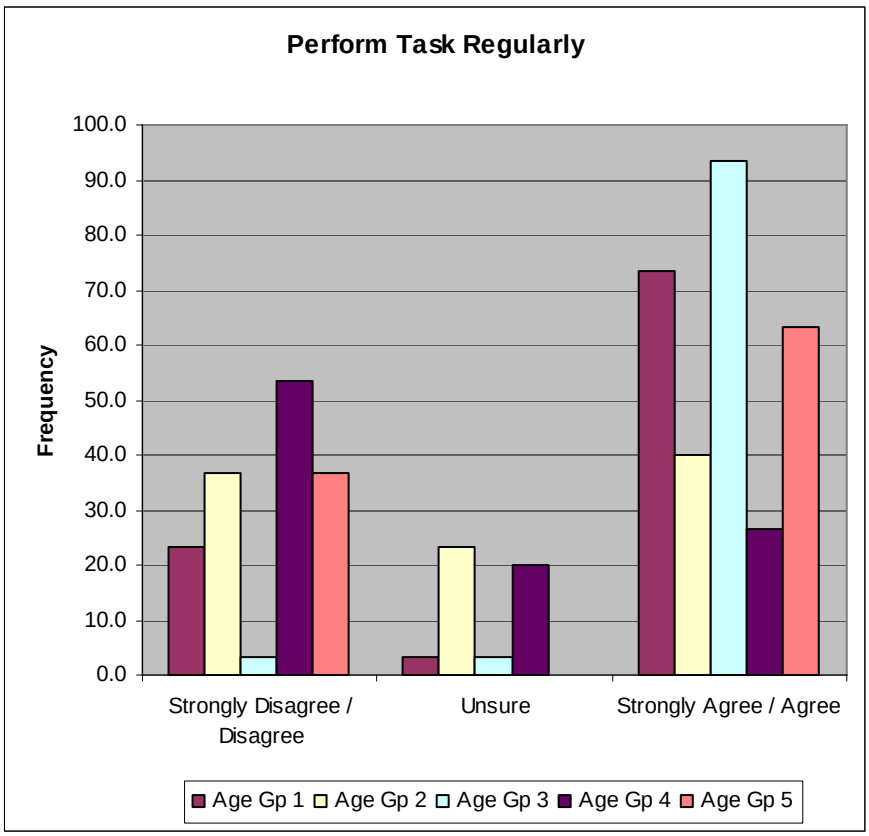

Figure 5.1.10 Perform task regularly.

Age Group Summary:

Denominator Status: *Composite*

The majority of workers agreed that the task in which they were hurt, they performed regularly. If tasks are performed regularly they should potentially be experienced at that task and this denominator should align with being experienced. The evidence presented in Figure 5.1.10 indicates a larger proportion of workers being hurt in performing tasks they do regularly, as compared to tasks they are very experienced at. This would suggest that experience and regularity are not synonymous. Workers could potentially be assigned new tasks to be performed on a regular basis, without adequate previous experience in that task, predisposing them to potential injury. However, there are also a significant number of injuries associated with workers performing infrequent tasks. Figure 5.1.10 suggests frequently performed tasks are resulting in more injuries than infrequent tasks. While it is theorized there may be many reasons contributing to this finding, current data is unable to provide a reason.

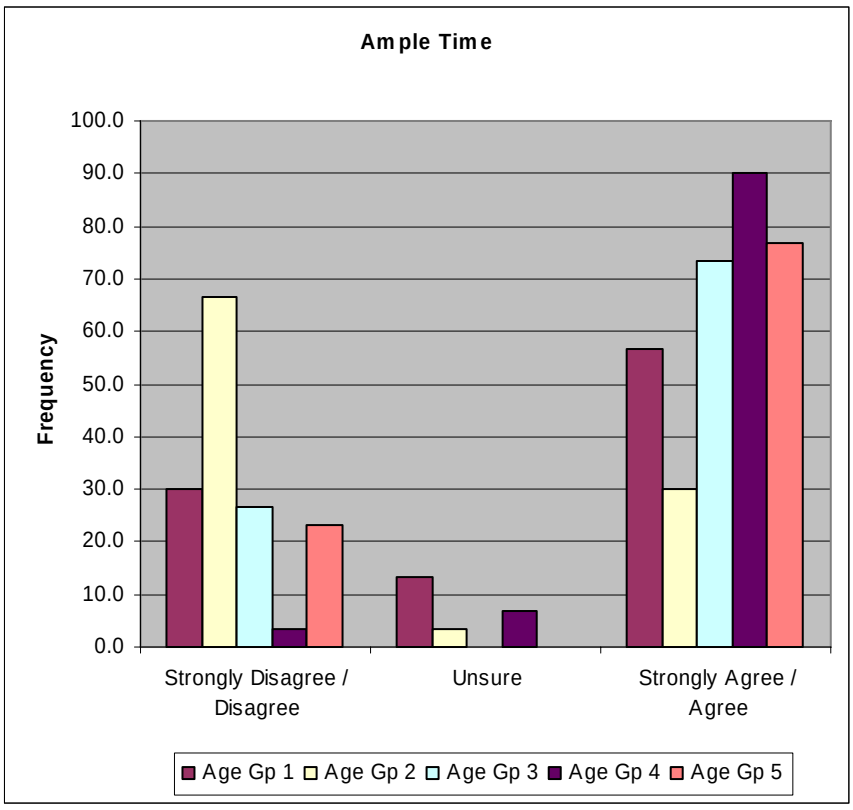

Figure 5.1.11 Ample Time

Age Group Summary:

Denominator Status: *Composite*

Figure 5.1.11 indicates 66.7% of age group 2 suggested they did not have enough time to complete the task safely while 30% indicated they did. As this finding appears to be the inverse of the other age groups, potentially this trend may be impacted by other variables such as industry type. Primarily this denominator emerged as a strong mitigator and that most of the injuries occurred whilst performing a task in which there was ample time to complete it safely. Age group 2, having displayed an inverse trend to the other groups is potentially indicative that some workers are influenced by time constraints which contributed to their injury.

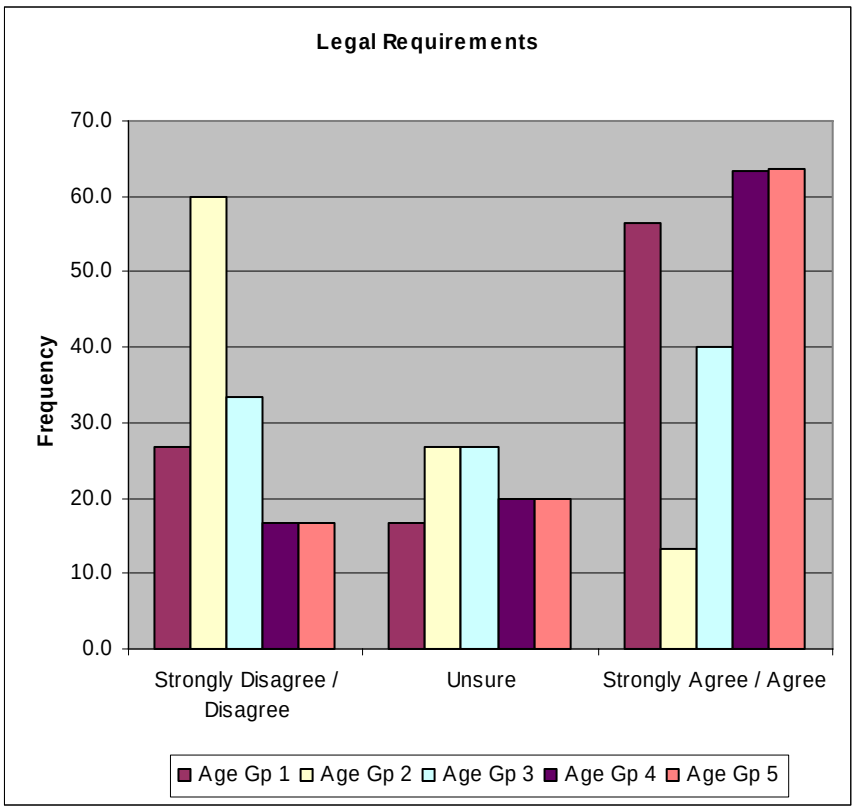

Figure 5.1.12 Aware of Legal Requirements

Age Group Summary:

Denominator Status: *Passive*

This age group 2 indicated they were not aware of all legal requirements associated with the task in which they were injured. Nor is it clear whether lack of knowledge was a contributor. This lack of clarity applies to all age groups for this denominator as indicated by the unsure scores in Figure 5.1.12.

Two trends emerged from the data. First, age group 2 claimed to be less aware than the other groups. Collected data does not permit a deeper investigation and it is theorized this finding may be affected by other variables and also requires further research as outlined in section 6.4 of this report pp 84. Second, even though there was a strong score towards this denominator acting as a mitigator, it is not clear that knowledge of legal requirements actually did mitigate. Nor contribute for the converse. For example, knowledge of a Duty of Care to wear personal protective equipment (PPE) may not be the driver causing an individual to wear PPE. Experience, training or sound hazard identification skills could potentially be the real driver. Therefore this denominator is assigned the status of passive.

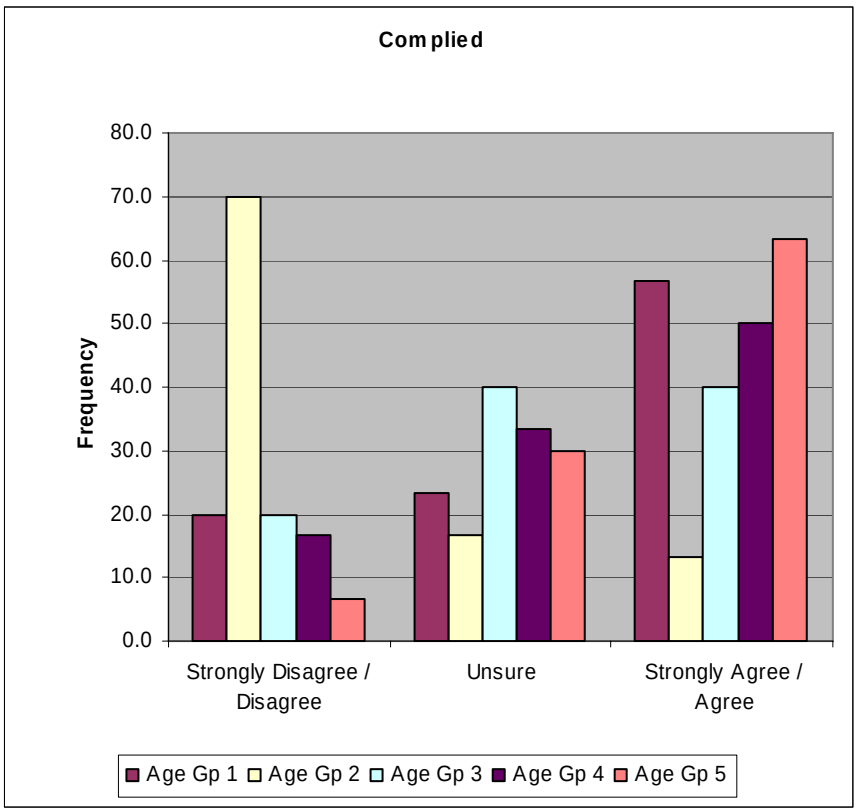

Figure 5.1.13 Complied with Legal Requirements

Age Group Summary:

Denominator Status: *Mitigator*

Two key issues arose regarding this denominator similar to that of "legal requirements". First, while "legal requirements" was assigned the status of passive, potentially due to other variables, the choice not to comply once a worker has knowledge of these requirements suggests this denominator be defined as a composite denominator. Figure 5.1.13 indicates this to be true, particularly with age group 2. It is suspected that the extra strong score by age group 2 may be an assumed non-compliance, on their behalf, due to lack of knowledge. There is no evidence in the collected data to support this suggestion.

Conversely, if a worker does not possess knowledge of legal requirements, then they could not be aware whether they were complying or not. Therefore the score of 70% for group 2 may be unrealistic. This suggests other variables potentially influencing their work behavior and not necessarily an impact from this particular denominator.

Logically, the status for non-compliance should be assigned as passive due to the score for unsure in Figure 5.1.13. However, complying with legal requirements is not only essential; it must be regarded as a mitigator.

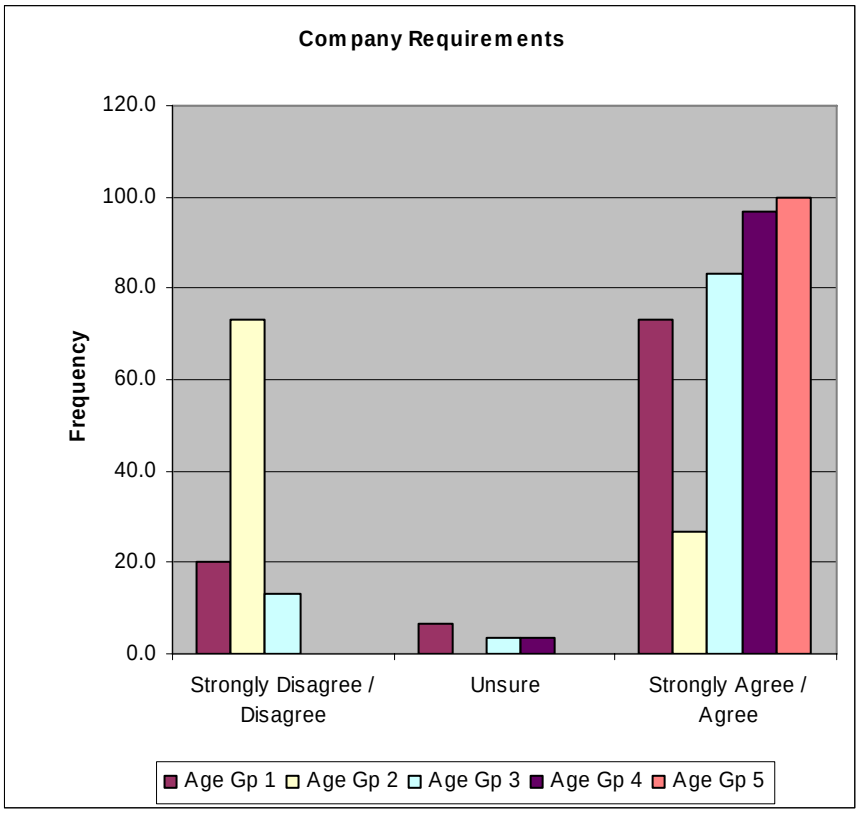

Figure 5.1.14 Aware of Company Requirements

Age Group Summary:

Denominator Status: *Mitigator*

With the exception of Age Group 2, the majority of workers were aware of their company's safety requirements. It is not clear whether this knowledge had a mitigating effect or not (similar to legal requirements). However, in this case, most workers were very sure of their awareness, suggesting this denominator is assigned the status of mitigator. Why group 2 has emerged as indicating 73.3 % is unclear.

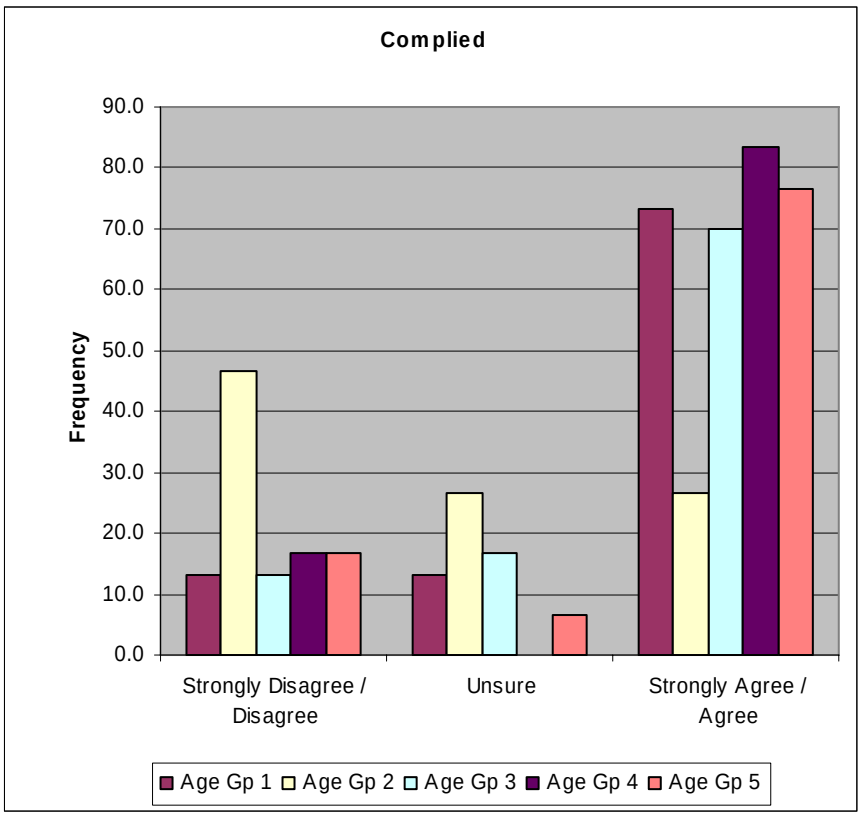

Figure 5.1.15 Complied with Company Requirements

Age Group Summary:

Denominator Status: *Mitigator*

This denominator exhibits a similar trend as did awareness of company requirements, with the exception that Figure 5.1.15 indicates an increased number of workers being unsure. This suggests that even though workers believed they had knowledge of company requirements, they were unsure if they were complying at the time of their accident. This apparent lack of understanding may suggest knowledge of rules and the safe application of rules is not well understood by all workers. The practicality of applying rules to meet the intent may be lost by some workers to the detriment of safe working practices. Most workers agreed they complied and that their accident was due to other agencies, suggesting mitigator a status for this denominator. However, particularly group 2, indicated lack of compliance even though they scored 75% for lack of awareness of company requirements in Figure 5.1.14. on pp 50. This result suggests there may be an assumed lack of compliance by this group for this denominator. Even though a number of workers indicated they were unsure of compliance, this denominator was still deemed to be a mitigator.

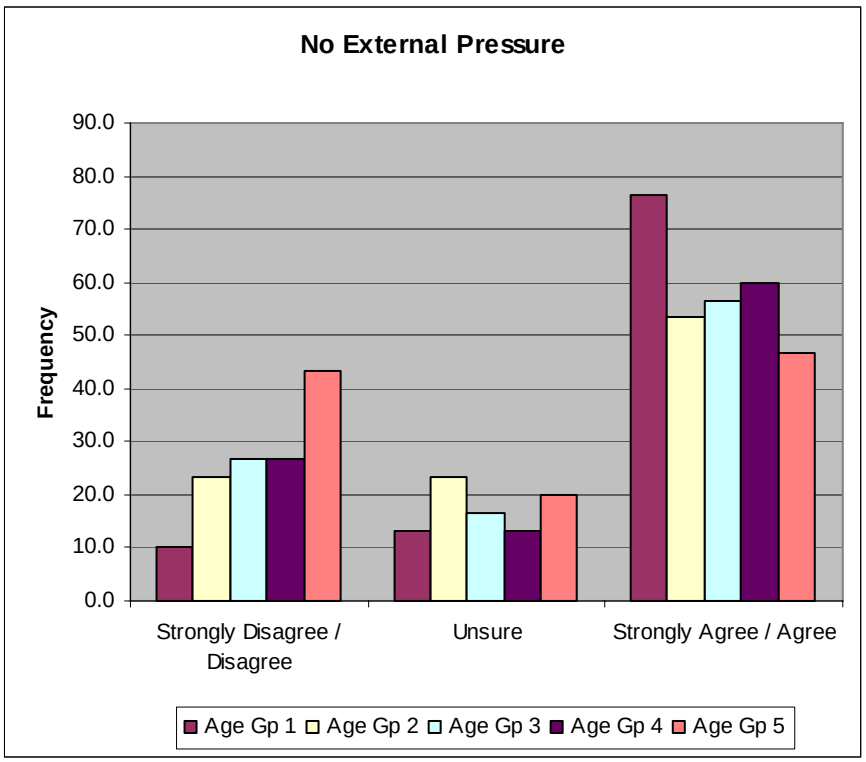

Figure 5.1.16 No External Pressure

Age Group Summary:

Denominator Status: *Composite*

The majority of all age groups concurred they were not under any external pressure at the time of their accident. In particular age group one appeared least affected by external pressure and age group 5 the most affected. The significant numbers who indicated they were unsure appear to be unable to link external pressure to their accident or simply had none. It is theorized that most individuals are under external pressures to some degree and the in some instances such pressure may impact workplace safety. It is also theorized personal issues are potentially complex and other than identifying them, they are outside the scope of this report. Figure 5.1.16 reports significant scores from most groups indicating that a number of workers injured were affected by external pressures at the time of their accident, particularly age group 5. From these results it appears that external pressure plays a significant role in workplace safety. Denominator status is therefore assigned as composite.

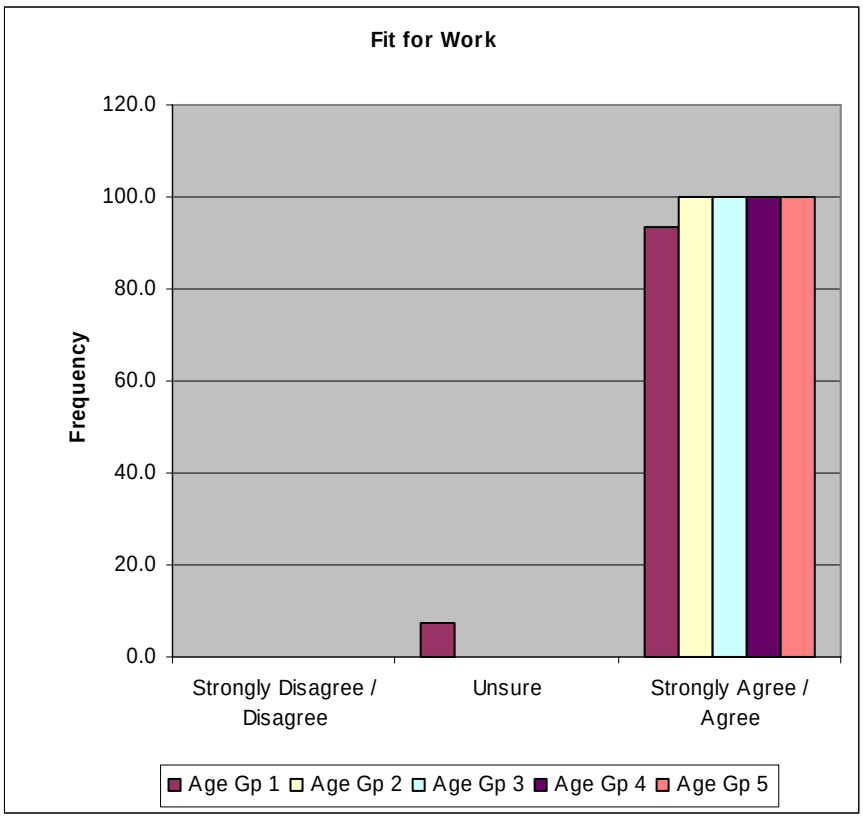

Figure 5.1.17 Fit for Work

Age Group Summary:

Denominator Status: *Mitigator*

All groups claimed they were fit for work at the time of their accident. The score would have been 100% had it not been for 7.6% of age group 1 scoring unsure. This denominator has scored heavily as a mitigator according the results shown in figure 5.1.17. The question of whether being fit for work actually mitigates or conversely, does being unfit for work contribute to unsafe practices is potentially a complex one and the definition of being fit for work is not always clear. Given the results contained in Figure 5.1.17 this denominator is assigned the status of a mitigator.

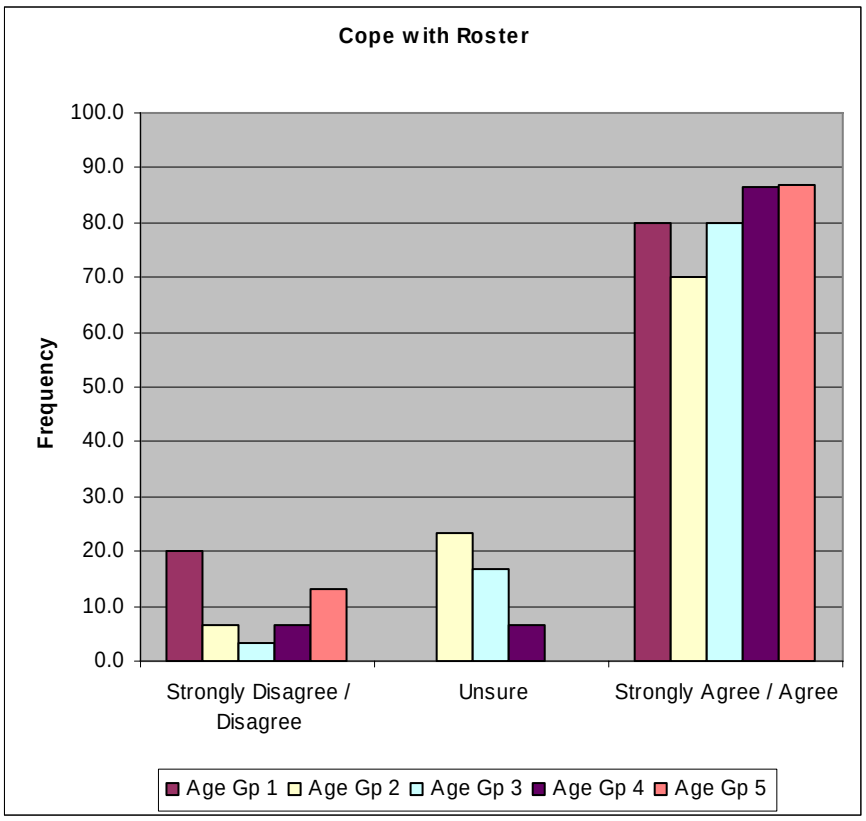

Figure 5.1.18 Cope with Roster

Age Group Summary:

Denominator Status: *Mitigator*

A strong score for mitigation indicates the majority of workers were content with their shift roster, having no negative effect on their safety performance. In Figure 5.1.18 20% of age group 1 and a small number of the other groups were not content suggesting their shift roster detracted from their safety performance contributing to their accident. This score suggests this denominator acted as a composite and a status of mitigator is assigned.

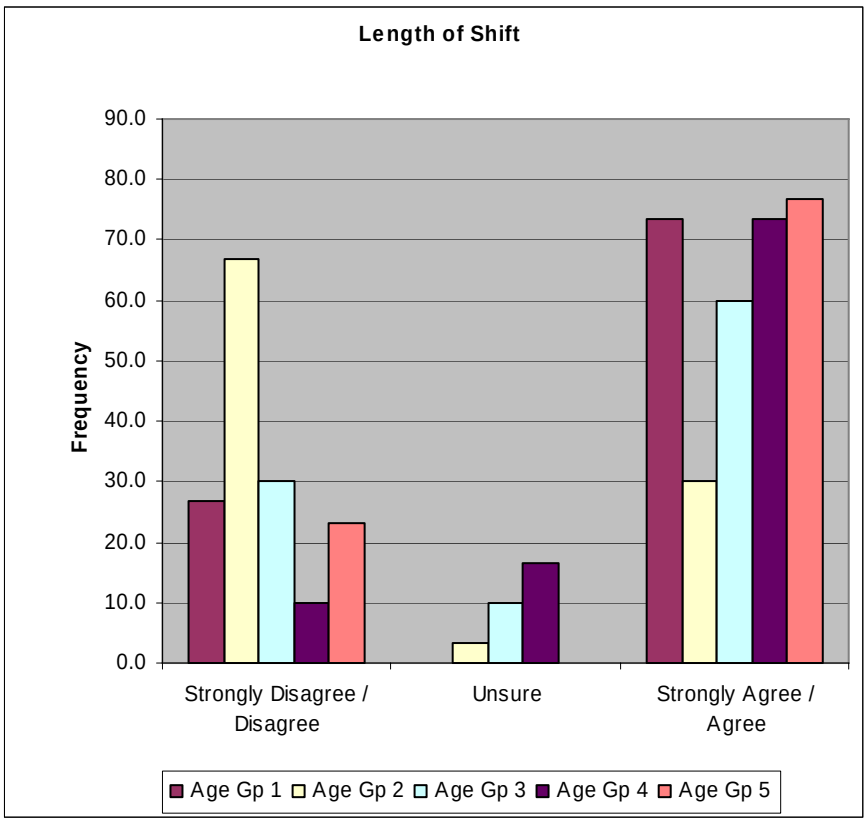

Figure 5.1.19 Length of Shift

Age Group Summary:

Denominator Status: *Composite*

While most workers were content with the shift roster they were working (Figure 5.1.18 on pp 54) indicating it played no part in their accident, not all workers agreed. Figure 5.1.19 indicates a significant number of workers suggested the length of their shift played a part in their accident. Again age group 2 differed markedly from the other age groups. At first glance this does not appear to make sense as age group 2 claimed they were content with their shift roster, just not the duration. The other age groups displayed a similar trend, though not as marked as age group 2. While most workers are content with the roster type they work, potentially the length of each shift may be of concern, suggesting fatigue issues. While Figure 5.1.19 indicated most workers were content with the length of their shift, a significant proportion was not leading to a denominator of composite being assigned.

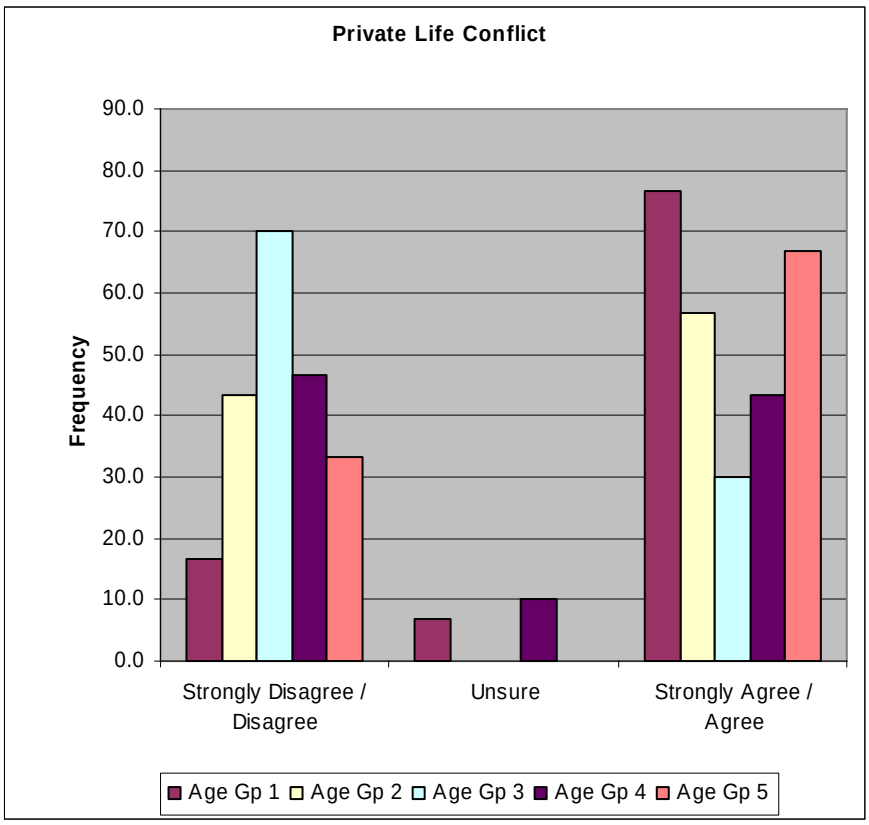

Figure 5.1.20 Private Life Conflict

Age Group Summary:

Denominator Status: *Composite*

All age groups indicated there was conflict with work hours and their private lives. While the details of conflict were not recorded, it is clear from the data in Figure 5.1.20 there is a fairly even balance between this denominators acting as composite.

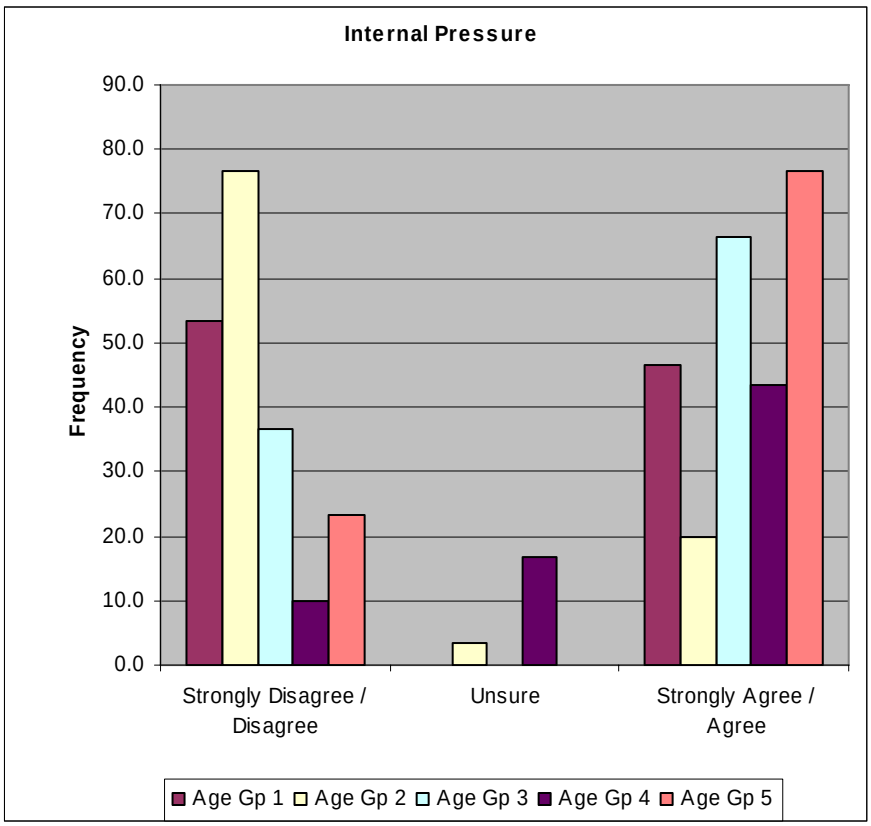

Figure 5.1.21 Internal Pressures

Age Group Summary:

Denominator Status: *Composite*

From Figure 5.1.21, age groups 1 and 2 scored the highest with 53% and 76% respectively claiming internal pressure from management had a negative effect on their safety performance, contributing to their accidents. This is particularly evident with age group 2. The three youngest groups being the most affected, with the two oldest age groups being the least affected. It is theorized that internal pressures exist in most, if not all, industry types as production receives a high priority. However, older workers may be better able to cope with these pressures. It is theorized that internal and external pressures both effect workers in a similar and may even produce a synergistic effect. Few workers indicated they were unsure, therefore this denominator is assigned the status of composite. The effects of internal pressure placed upon employees requires further research as outlined in section 6.4 of this report pp 84.

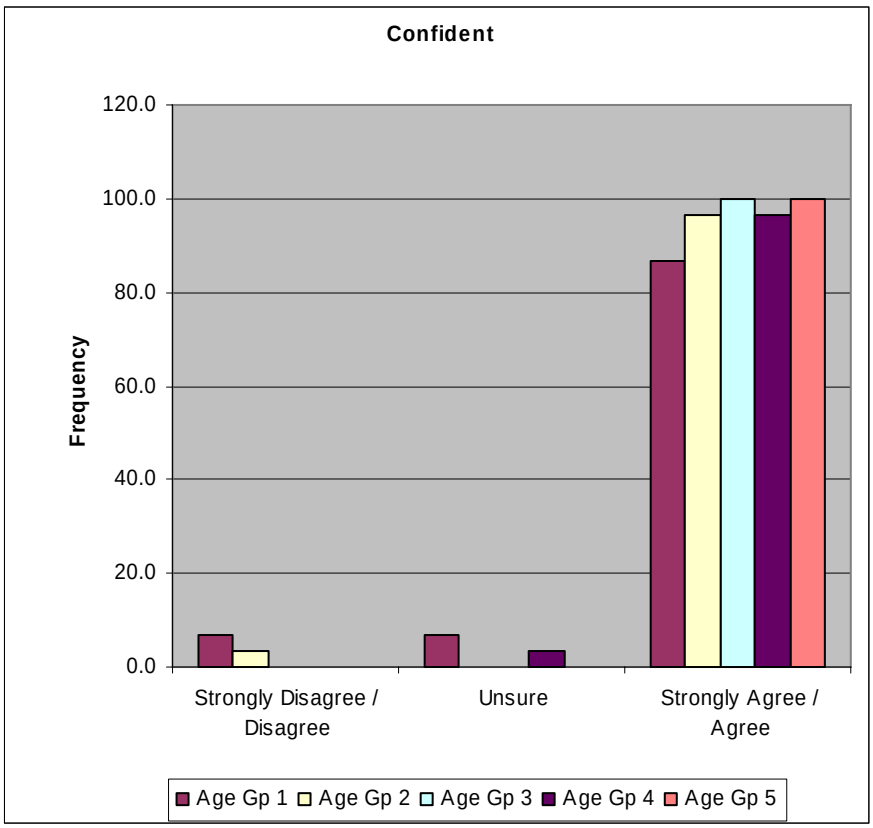

Figure 5.1.22 Confident

Age Group Summary:

Denominator Status: *Mitigator*

All workers with the exception of a small percentage were confident in performing the task in which they received their injury. Initially, this appears indicative of a mitigating denominator as a confident worker may potentially work with due attention to performing the task safely. Potentially most experienced workers are confident in performing their work and the results indicate this. It is suspected that over-confidence displays a negative alignment with complacency and that both potentially act as contributors. Collected data are incapable of differentiating between confidence and over confidence and the status of mitigator has been assigned.

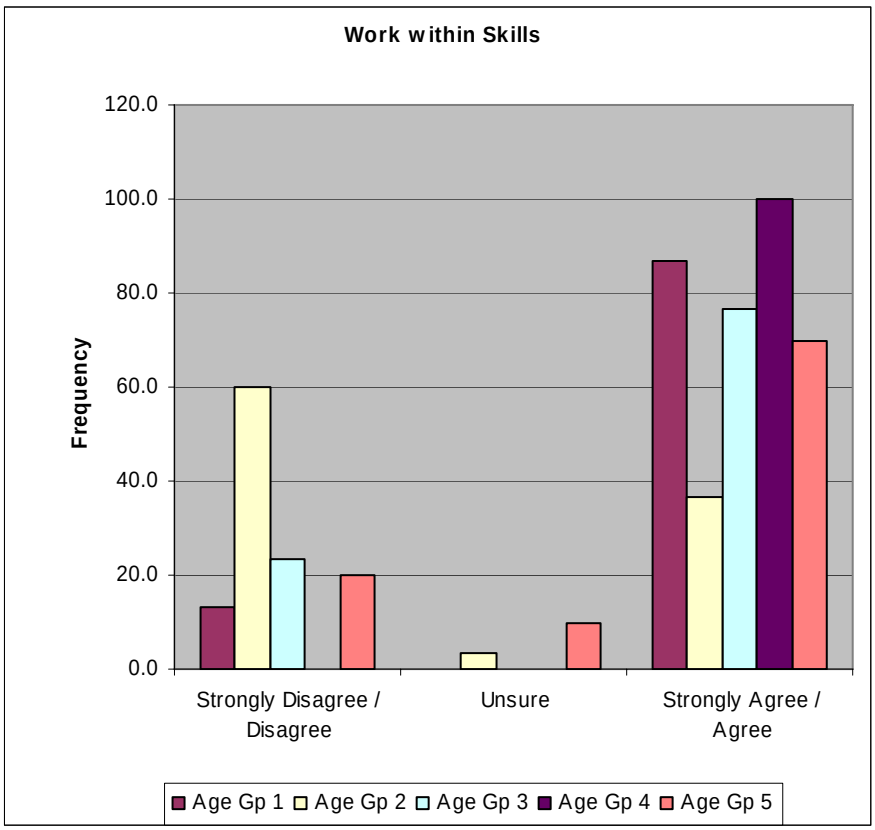

Figure 5.1.23 Work within Skills

Age Group Summary:

Denominator Status: *Composite*

Figure 5.1.23 indicates the majority of workers were working within their skill levels when injured. This is suggestive of other variables exerting influence at the time of injury. It also suggests that working within one's skill levels is a safe mitigating behavior. 60% of age group 2 was prepared to work outside of their skill levels when they were injured. Exactly why workers were prepared to work outside their skill level is unsure. Potentially denominators such as internal pressure or over confidence potentially impact causing unsafe work behavior, ultimately leading to injury. Also a significant number of other workers were prepared to do likewise. Only age group 4 claimed 100% for working within skill levels when hurt. Suggesting the older work groups have a higher skill level than younger groups or are better at identifying and controlling the hazards they encounter. This procedure should be considered a portable skill set, integrating as a component of task specific skill sets. Exactly what prompted workers to operate outside of their skill levels is unclear and may potentially align with other variables such as internal pressure, time constraints or complacency.

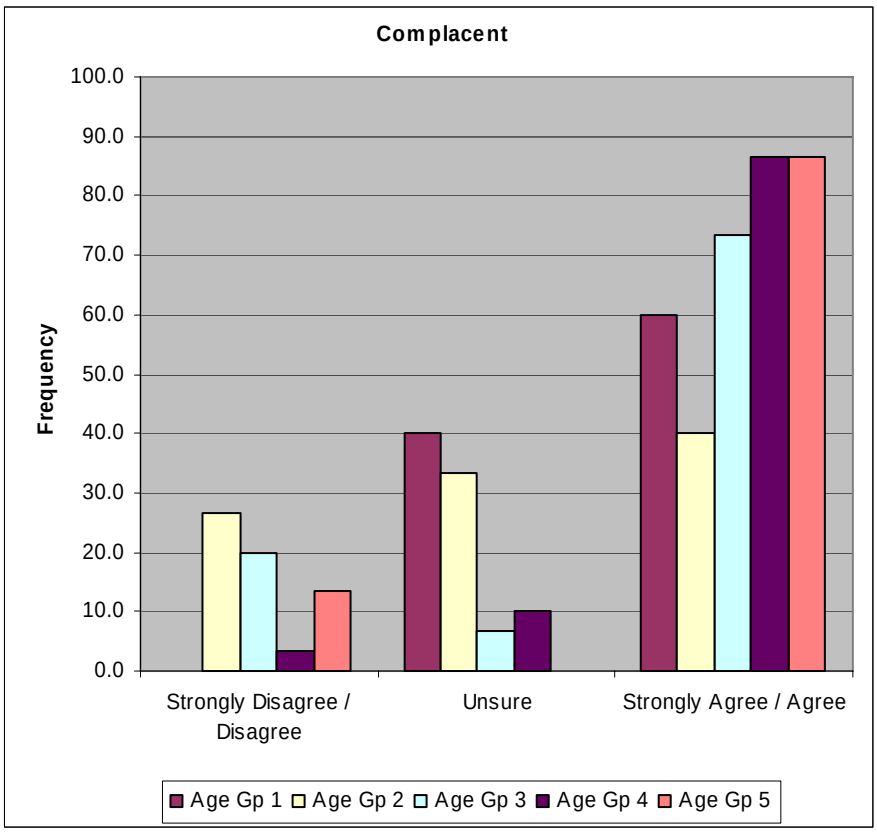

Figure 5.1.24 Complacency

Age Group Summary:

Denominator Status: *Composite*

Primarily this denominator emerges as a strong mitigator with most workers claiming they were not complacent at the time of their injury. However, members of all age groups admitted they had been complacent at the time of injury. Mechanisms underlying complacency and over confidence cannot be examined more deeply with the data collected and may well benefit from further study. For the purpose of this report this denominator appears to operate as a composite mitigator and contributor. Figure 5.1.24 indicates a significant number of workers were unsure whether complacency had an effect on their accident or not. This potentially suggests that complacency is not all that well understood by some workers and its effects may go unnoticed by some workers. A number of workers did admit to being complacent at the time of injury but it is unclear if this was realized prior to injury or not. It is theorized that complacency can only act a mitigator if the individual recognizes it takes conscious actions to ensure safe behavior.

Without recognition, complacency has the potential to permit unsafe work practices, therefore this denominator is assigned the status of composite regardless of the significant score for unsure in Figure 5.1.24 on pp 60.

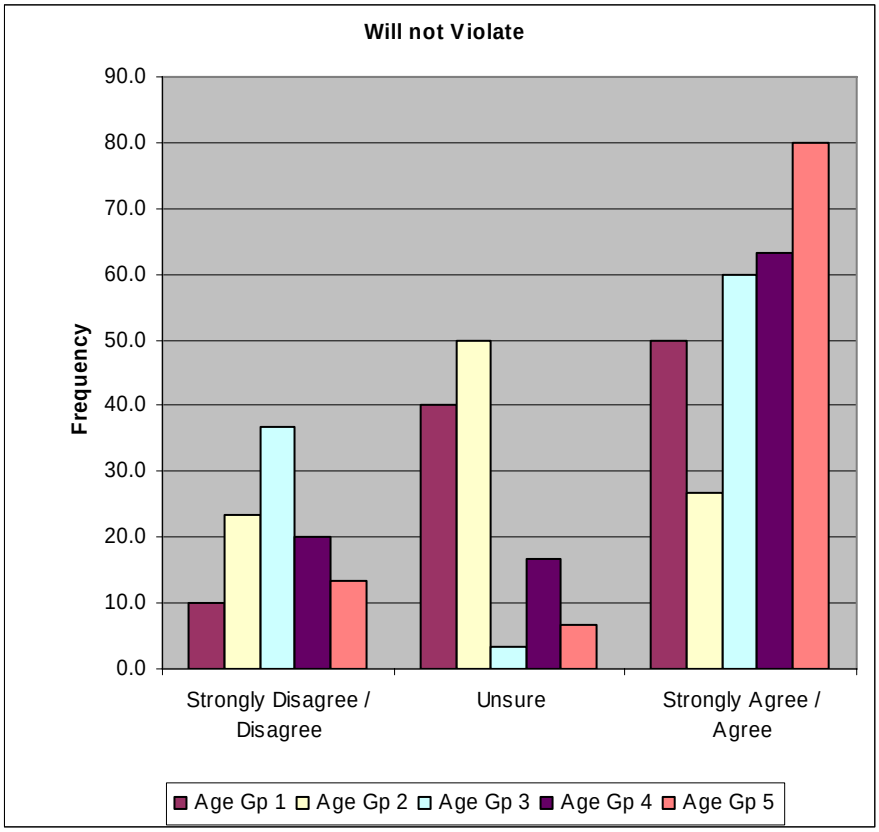

Figure 5.1.25 Will not Violate

Age Group Summary:

Denominator Status: *Composite*

Three distinct groups have arisen from the data contained in Figure 5.1.25. The majority of workers claimed they were not deliberately violating rules when hurt. However, another large group was prepared to violate and were doing so at the time of injury. Younger and older age groups were less prepared to violate but 37% of age group 3 were prepared to do so. Surprisingly, 40% and 50% of age groups 1 and 2 were unsure if they were violating or not. Potentially, knowledge of violating implies knowledge of the rules, tough the potential exists for a worker to inadvertently violate.

Prepared to violate indicated another composite denominator where a significant number of workers from all age groups were prepared to violate rules and consequently injured in the process. With the exception of age group 2, the older workers became, the less they were prepared to violate. It is clear from the results violating is a composite denominator.

Reasons for violations were not captured and it is sufficient to indicate that violating safety rules may contribute and compliance with rules will have a mitigating effect. The fact that a significant number of workers from all groups are prepared to violate is suggestive that this denominator may be worthy of further study.

If a worker has full knowledge of the rules than the decision to violate has the potential to increase the risk of an injury. The converse implies safe practices employed, suggesting a mitigating effect. Therefore a denominator status of composite is assigned.

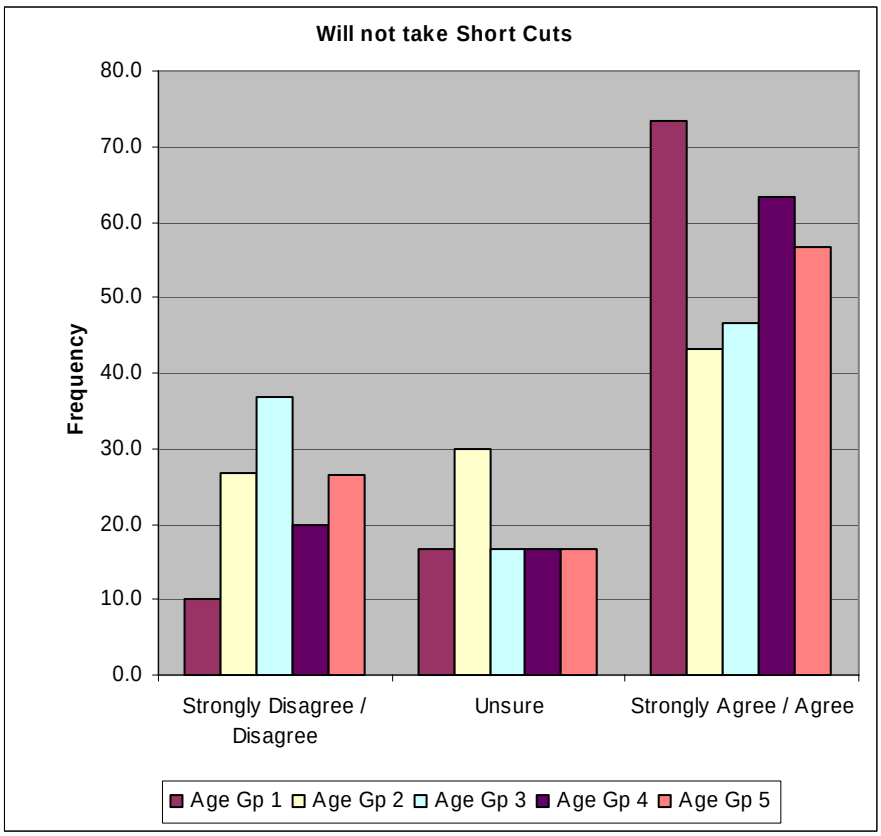

Figure 5.1.26 Will not take Short Cuts

Age Group Summary:

Denominator Status: *Composite*

This denominator displayed a similar pattern to the violating denominator with even more workers prepared to take short cuts and being injured in the process. It is suspected that the willingness to take a short cut may be aligned with other variables such as experience, complacency and task experience. Taking short cuts differentiates from violating as the short cut taken may not involve a rule violation. For example, to climb a fixed, steel, structural ladder after rain may not be against the rules. If the decision is made to climb it immediately and get the job finished is made without due controls put in place for the new hazard, an accident may occur. Many workers admitted taking short cuts when injured though Figure 5.1.26 indicates a significant number of workers being unsure if the short cut they too contributed to the accident or not. In any event, this denominator has emerged as a composite.

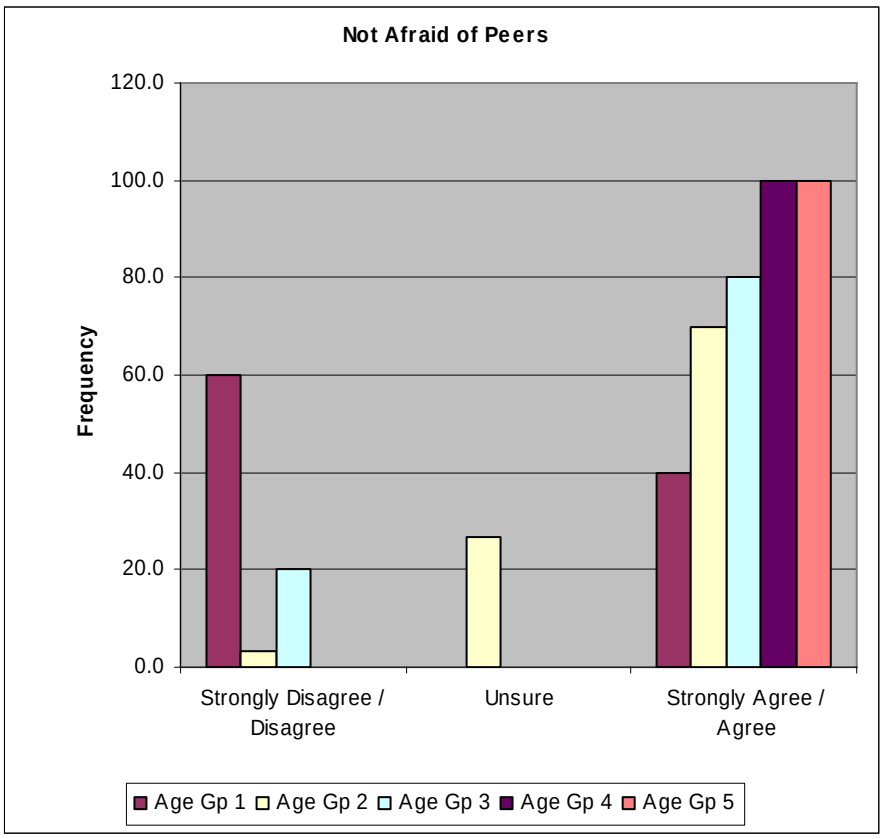

Figure 5.1.27 Not Afraid of Peers

Age Group Summary:

Denominator Status: *Composite*

From Figure 5.1.27 age group 1 indicated that 60% were afraid of their peers and were under some sort of peer pressure at the time of their accident. Only 40% were not under peer pressure. 0% indicated they were unsure suggesting a clear line of polarization between the two responses and that peer pressure contributes to accidents. The nature of the peer pressure was not revealed but the division represented polarization within this denominator, for this age group. It is theorized that young and new workers are particularly susceptible to peer pressure, especially by very experienced peers.

As workers progress to older groups they potentially become less susceptible to peer pressure, potentially because as experience increases, they rely less on input from peers and are confident to stand up for themselves. As workers progress through the age groups there is a heightened potential for them to become respected peers who now are capable of exerting peer pressure themselves.

This denominator scored primarily mitigating but due to its significant status on the youngest group, it is best classified as a composite.

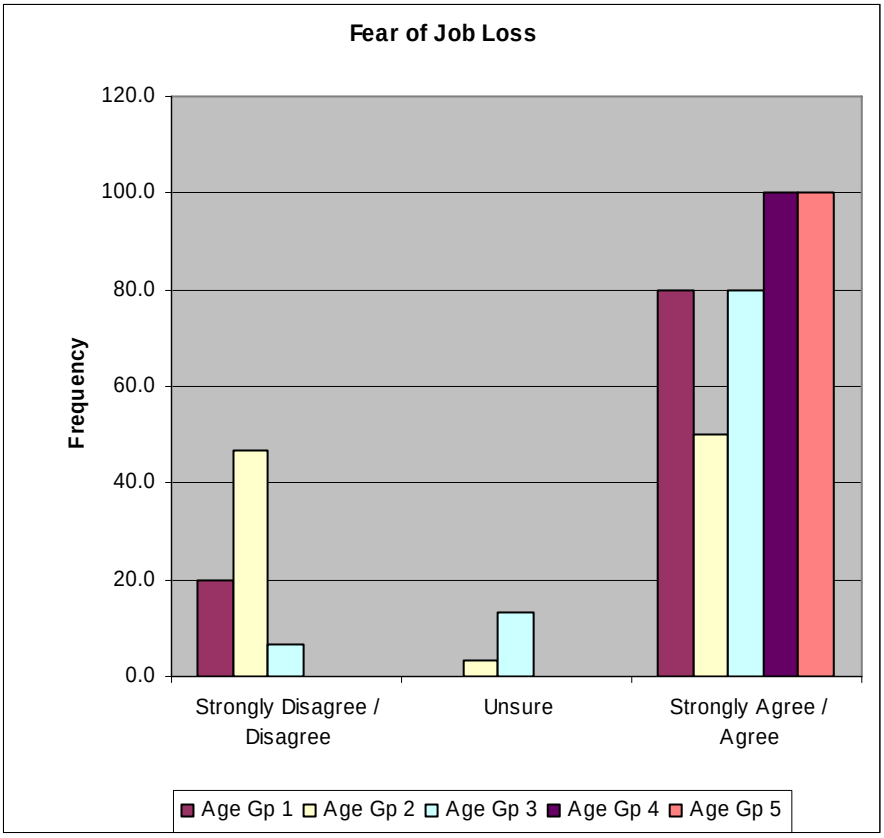

Figure 5.1.28 Fear of Job Loss

Age Group Summary:

Denominator Status: *Composite*

Once again, the younger workers appear to fear more for their jobs than do older workers; particularly age group 2 who indicated they were in fear of job loss at the time of injury and indicated that this fear contributed to their accident. Why this fear should be heightened in group 2 is unclear. The older a worker became, the less they appeared to fear job loss, and the two oldest groups indicated no fear at all. Potentially, due to retirement becoming a real possibility for them in the near future and they were not all that concerned anymore.

This denominator also primarily acts as a mitigator but due to its heightened effect on younger and new workers, it is assigned as a composite.

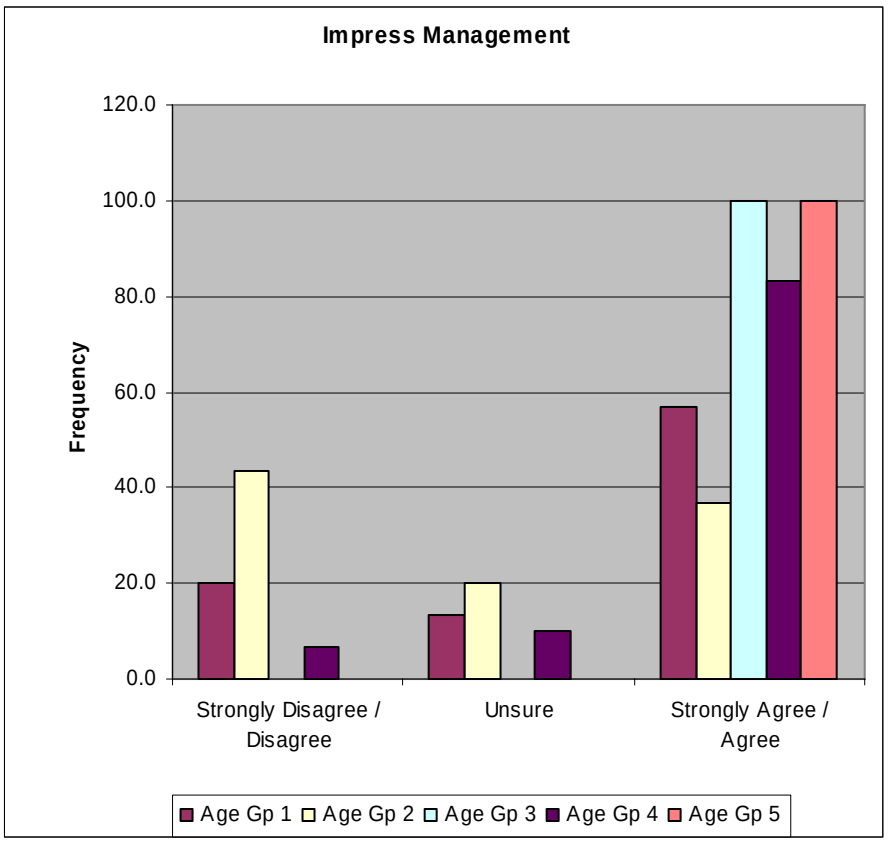

Figure 5.1.29 Impress Management

Age Group Summary:

Denominator Status: *Composite*

Figure 5.1.29 presents similar pattern as the previous denominator. The majority of workers were not out to impress management. Age groups 1 and 2 revealed 20% and 40% respectively were trying to impress. This denominator also is assigned a status of composite due its contributing effect on the younger age groups.

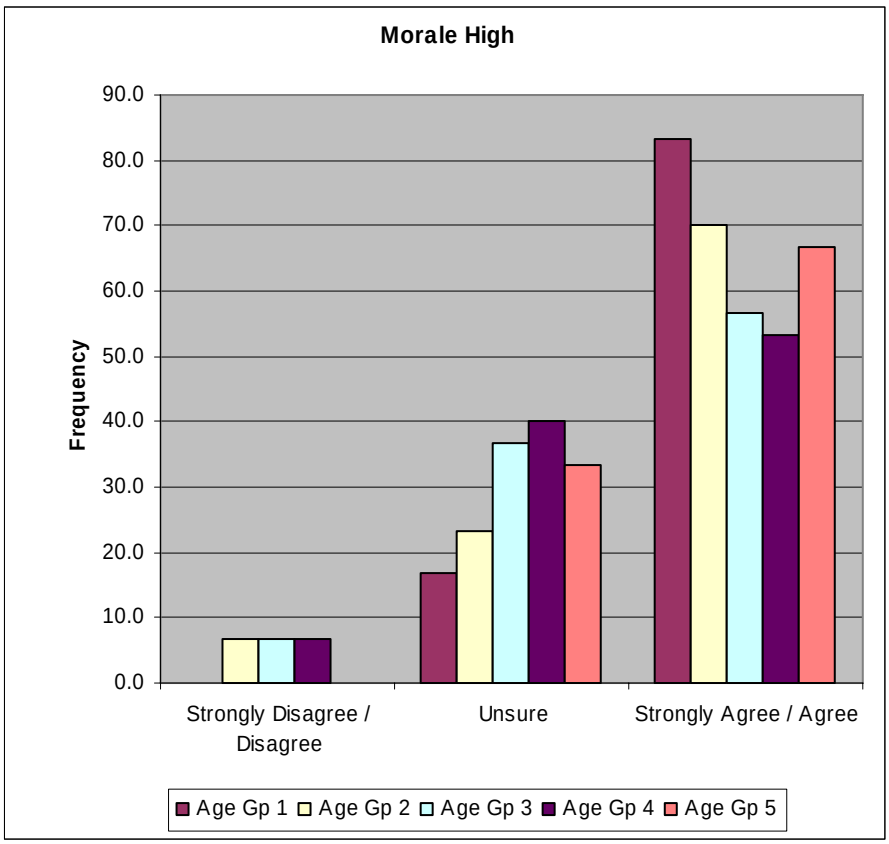

Figure 5.1.30 Morale High

Age Group Summary:

Denominator Status: *Mitigator*

Most member of all age groups indicated their morale was high at the time of their accident. Figure 5.1.30 displays a small number of workers who claimed that morale was not high at the time of their accident but their numbers have not been considered significant. However a significant number of workers were either unsure of their morale status or unsure if their morale status impacted on their accident. This result is potentially suggestive that morale in some industry types may not be high. This denominator is assigned the status of mitigator.

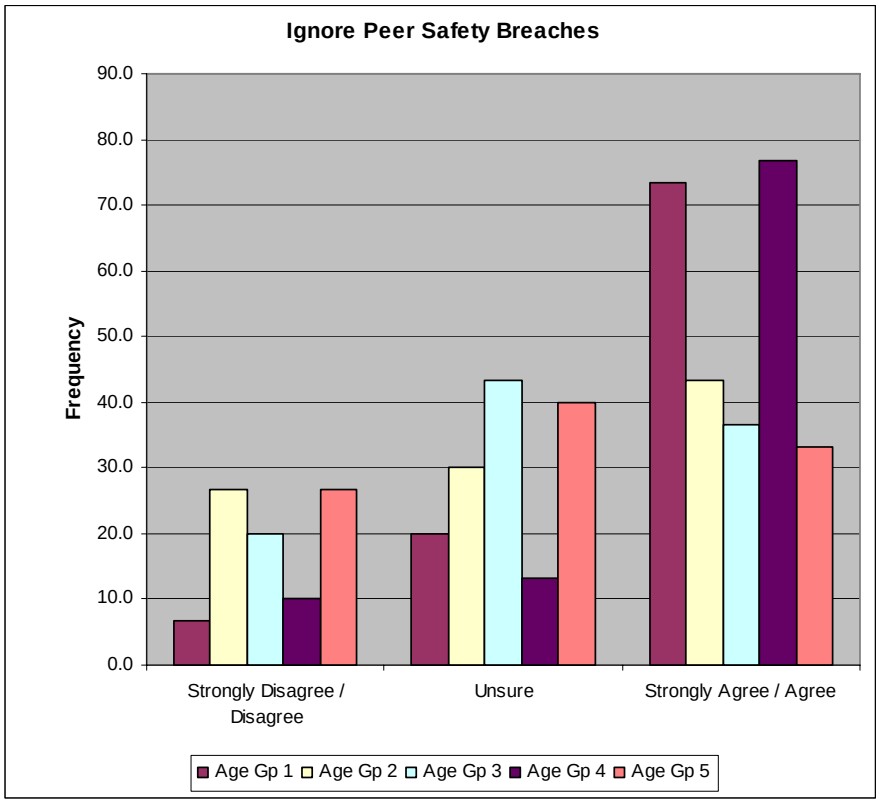

Figure 5.1.31 Ignore Peer Safety Breaches

Age Group Summary:

Denominator Status: *Composite*

The majority indicated they were not prepared to ignore safety breaches by peers and were not afraid to say so. However, a significant number were prepared to ignore peer safety breaches. It is unclear why they were prepared to ignore the breaches. By ignoring breaches the potential exists for future breaches to precipitate an incident or an accident. Therefore this denominator may act as a contributor. Potentially, addressing breeches on a peer level requires a level of courage and self confidence that not all workers may possess. Trending indicates these qualities may develop with age and experience as older workers appear to be more likely to intervene at a peer level. Figure 5.1.31 indicates a strong score for unsure across the age groups thereby assisting to define this denominator as a composite.

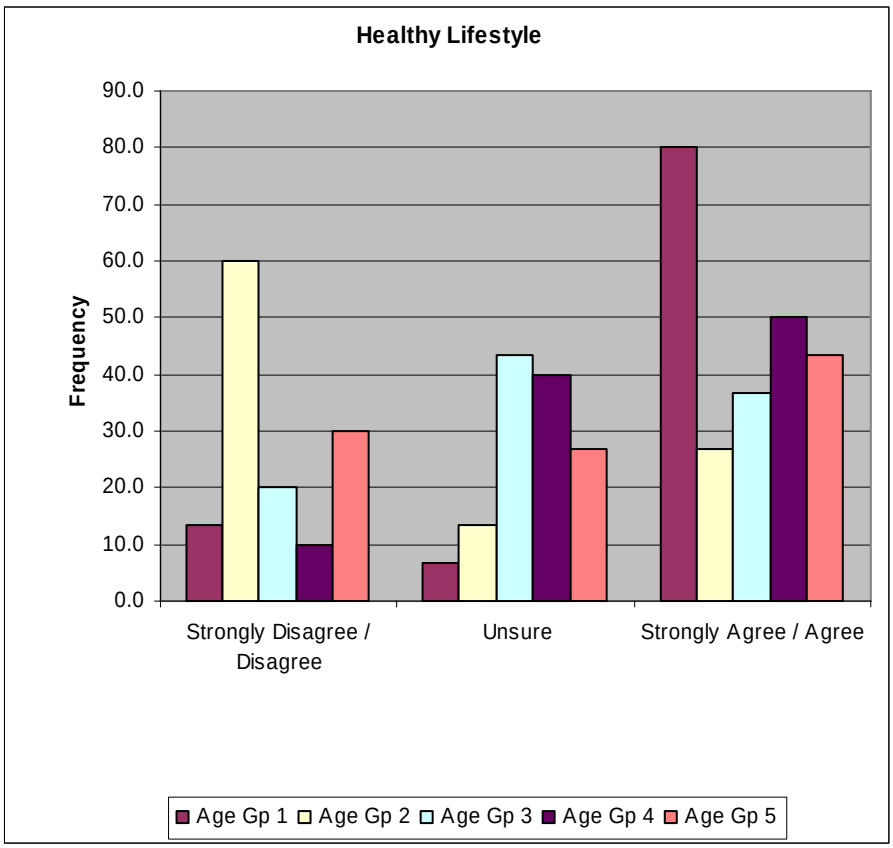

Figure 5.1.32 Healthy Lifestyle

Age Group Summary:

Denominator Status: *Composite*

Most workers claim they lead a healthy lifestyle. However, no guide lines were given and it was up to individuals to decide for themselves. Therefore some degree of subjectivity may potentially be present. The intent of this denominator was to gain worker opinion regarding the status of their lifestyle on potential accidents at work and therefore subjectivity is taken as an acceptable confounder for this purpose. Figure 5.1.32 age group 2 stands out with 60% admitting their lifestyle may potentially impact safety at work. A significant score for unsure indicated a composite status would be appropriate for this denominator. Information was not collected regarding details of their life style as it is perceived that such information would not affect the denominator status of composite.

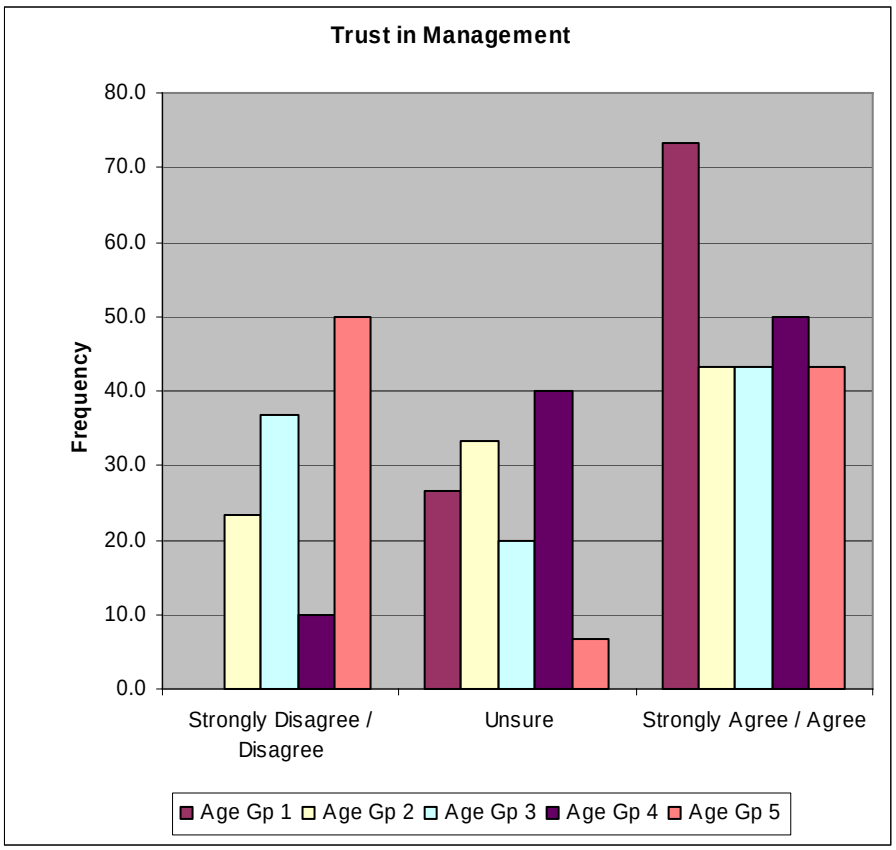

Figure 5.1.33 Trust in Management

Age Group Summary:

Denominator Status: *Composite*

Figure 1.5.33 Indicates that there appears to be a strong trust in management from all age groups, especially in age group 1 where 73.3% trusted management and the remainder being unsure. Nobody from this group indicated they distrusted management. This result is not surprising given the potential for extra attention to this group in terms of training, supervision and involvement in the learning of new tasks. The level of trust dropped off with age group 2. There was no evidence to suggest why their trust in management declined. However, potentially this could be the effect of a decrease in attention level as they have become experienced, receive less training and a lower level of supervision. Even so, 33.3% were still unsure if they trusted management or not. The trend of management distrust intensified with age group 3. It is also unclear why but it is theorized trust may be industry type specific. Trust in management requires further research as outlined in section 6.4 of this report pp 84.

Age group 5 had the highest level of distrust and there appeared to be an increasing trend to distrust management in older groups; the exception being age group 4, who displayed the lowest level of distrust for all age groups. It is not clear why this is so. This denominator is clearly identified as composite.

Summary of Results:

Table 5.1.1 on pp 35 summarizes the denominator status assignations. Three passive denominators were identified and as they are passive denominators do not contribute, they can therefore be ignored from further discussion. One denominator was identified as a contributor only; though ten were identified as being sole mitigators. The majority of denominators were considered to act as composites, possessing significant mitigating and contributing effects on accident group dynamics. All active denominators have the potential to input to accident group dynamics.

Seven of the eight key denominators derived from the literature review were identified as significant denominators pertaining to the test sample. Only one did not. Gender, as a denominator was omitted, less than 1% of the participants were female rendering it impossible to achieve a statistically significant sample for this denominator. This was purely due to chance selection from the participating industries. **Training** was identified as a **mitigating denominator** for this sample. **Industry Type** is discussed in the "Accident Output" section of this report. **Supervision, Experience** and **Task Performed** were all identified as composite denominators possessing the potential to contribute or mitigate.

Importance of Identifying Denominators:

The importance of identifying denominator characteristics is to provide industry with corrective foci to prevent a reoccurrence of accidents impacted by the contributing component of denominators; potentially reducing accidents and increasing attenuation of prevalent trailing indicators in their respective accident statistics.

Mitigating denominators attenuate the effects of an accident or potentially preventing an accident entirely. Mitigators are basically an indication of sound practices comprising a safety management system translated into safe practices in the work place. They deserve attention as they potentially provide reassurance and reinforcement to groups and individuals alike and may impact worker morale.

They also provide management and supervision with the opportunity to focus on safety positives. The presence of a mitigator may not be easily perceptible. For example, it may be difficult to evaluate the impact of experience etc, in the absence of an accident. Therefore mitigators may be considered subjective in character and difficult to evaluate, even though their outcomes are measurable.

A composite denominator can impact a group as a contributor or a mitigator concurrently; possessing both quantitative and qualitative aspects. Both aspects of composites tend to suggest corrective and reinforcing foci concurrently. This is acceptable though it is important to ensure improvements are captured in the company's safety management system rather that with work groups alone, to ensure improvements are sustained in the event of personnel changes.

It is theorized in industry, the potential of reinforcing mitigating denominators is overshadowed by concerted attention and effort being focused on contributors. Corrective actions tend to be favored over preventative actions. The concept mitigator reinforcement and its effects requires further research as outlined in section 6.4 of this report pp 84.

5.2 Accident Output Research Results

In the Theoretical Frame work of this report it was stated the model upon which this report is based was not intended to be a causation model focusing on unsafe acts and conditions etc. The outputs of accidents were defined as per Kahler and Ellis, (Kahler & Ellis, 2002, pp. 1-2) and as such individual accident details are not required, just the groupings, this information is sufficient to provide a corrective focus. For example, if body part effected is the back and human energy is involved with a single traumatic exchange; then the corrective focus might be aimed and lifting issues.

Potentially accident output patterns may vary across the age groups or that certain output characteristics might be specific to particular age groups. During the discussions when assigning status to input denominators it was suggested that certain characteristics may have been influenced by other variables; specifically, Industry Type.

Industry Type in not strictly an accident output as it does not arise as a consequence of an accident. Nor should it be considered an input as all industries should have the capacity to manage safety within their industry. Even when considering some industries present different hazards to their workers. However if hazards are adequately recognized and appropriate controls put in place; all industries potentially have the capacity to keep their workers safe. Therefore it is theorized that Industry Type is neither an input nor an output but rather a description of how well a particular industry is managing specific hazards. For example, if workers in a particular industry predominately suffer burn injuries, then a corrective focus has been identified potentially specific to that industry. For the purpose of this report, Industry Type has been assigned as an accident output for the purpose of identifying Industry Type characteristics should they be present.

Appendix Tables 7.5 to 7.9 from pp 88 - 94 in appendix 7.0 inclusive record the results of the output accident data. These tables have arisen from a frequency analysis split for age groups. Figures 5.2.1 to 5.2.5 pp 73 – 75 present the frequency data for each output in histogram form.

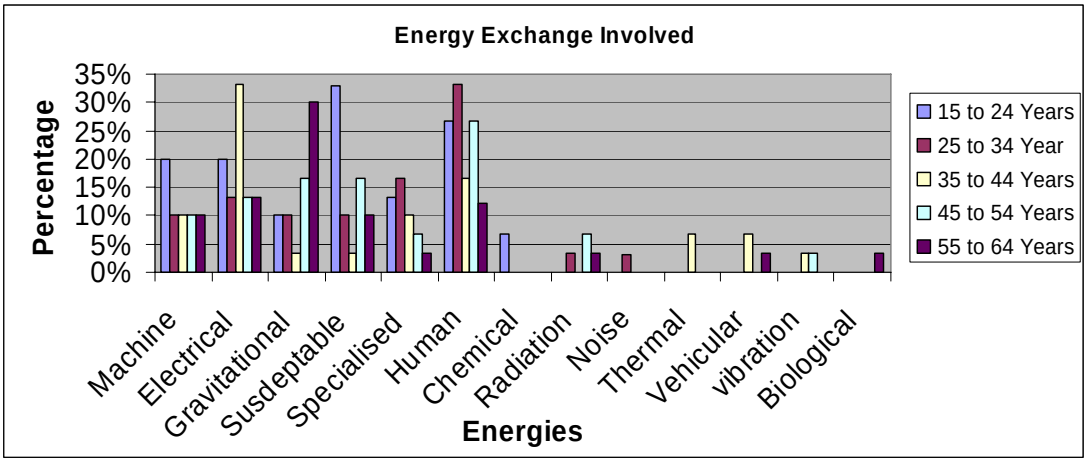

Figure 5.2.1 Energy Exchange Involved

The above Energy Exchange Involved descriptions are defined on pp 15

From Figure 5.2.1 **Energy Exchange Involved** it can be seen that the five most prominent energy exchanges involved are **Machine, Electrical, Gravitational, Susceptible Parts** (low level blows to sensitive body parts) and **Human Energy.**

Those injured by machine energy were hit, crushed or caught up in moving machinery. Age group 1 being the most affected with twice as many being injured than in any other of the age groups. This pattern is in accordance with the literature review findings.

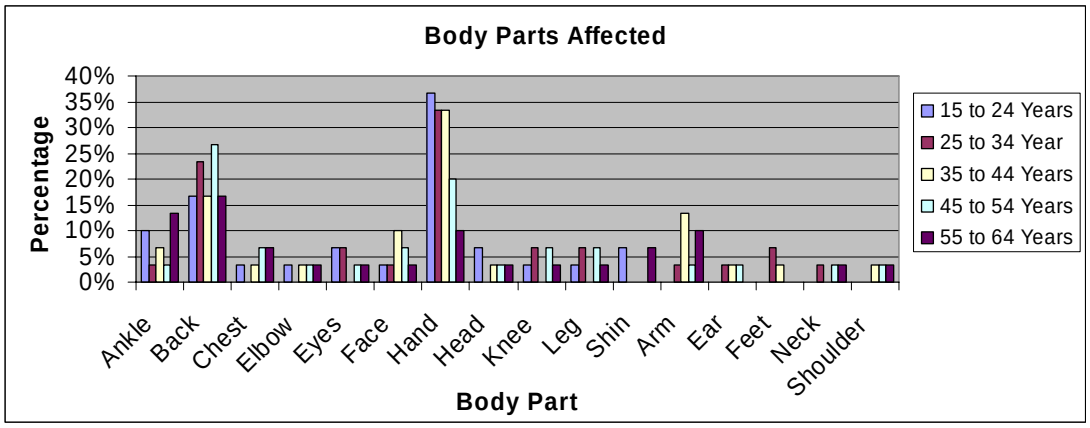

Figure 5.2.2 Body Part Affected

Hand and back injuries were the two most prominent body parts to be affected. Hand injuries accounted for the majority of injuries impacting mainly age groups1, 2 and 3. Back injuries affected all of the age groups with the majority being attributed to age groups 2 and 4. All other injuries were fairly evenly spread across other body parts.

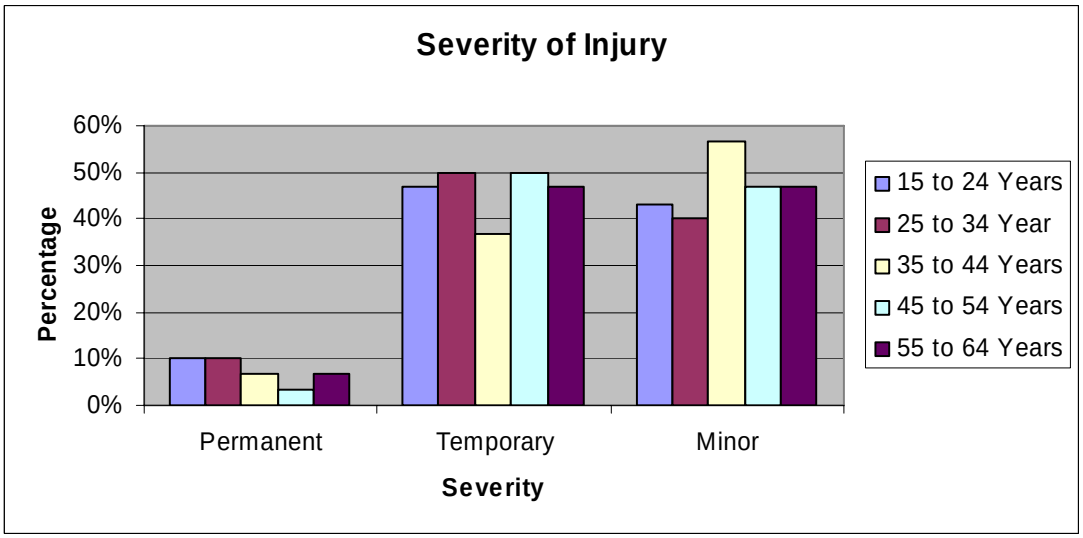

Figure 5.2.3 Severity of Injury

Very few permanent injuries were recorded from the sample with a nearly equal spread of temporary and minor injuries across all age groups with no discernable trends evident. A small number of permanent injuries were recorded.

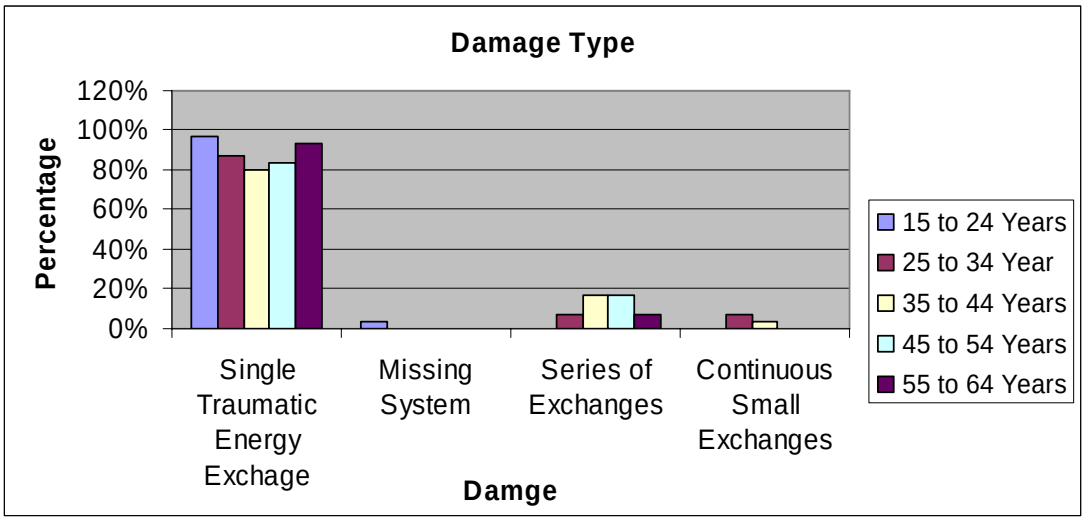

Figure 5.2.4 Damage Type:

Nearly all injuries occurred as a single traumatic exchange such as a blow, fall etc. The next significant though small group involved a series of small exchanges such as pushing and pulling or machine vibration and jolting resulting in back injuries. A small number involved long term exposure to continuous small exchanges over a long period of time, such as noise. Given the age groups, it is surprising that a larger number of this damage type was not reported in the form of hearing loss.

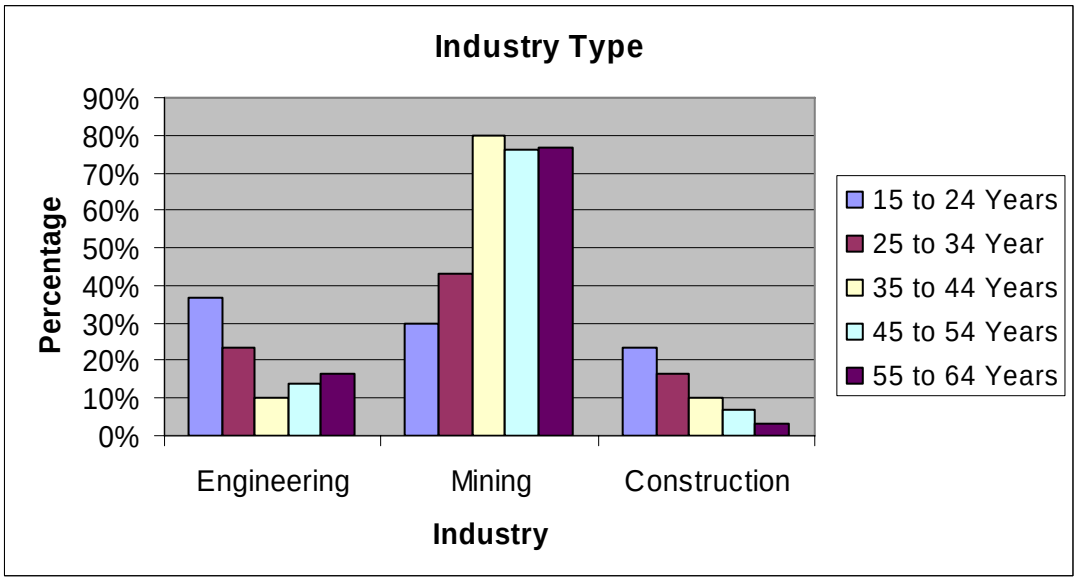

Figure 5.2.5 Industry Type

Figure 5.2.5 does not represent the frequency of accidents occurring in each industry type. It represents the overall number in the sample coming from each industry type. From this it can be seen the numbers are predominantly from the mining industry. Engineering and construction industries are not proportionally represented.

Therefore this information is biased towards mining and this fact may confound the wider application of the findings of this report.

5.3 Results and Discussion:

This summary brings together the findings of accident denominators in terms of whether they contributed, mitigated or both, arranged by age groups. This assessment is required to identify potential characteristics relative to age groups. This summary also brings together accident output information arranged in age groups for a similar assessment. This information is required to answer the research questions and for comparison with the findings of the literature review.

Results arising from this report may suggest scope for the implementation of appropriate safety initiatives within the industries concerned to augment current safety management systems. The study identified a number of significant denominators that can potentially be used to provide direction for company's to improve their safety performance.

5.3.1 Accident Denominators:

Accident denominators were classified as being contributors (**C**) or mitigators (**M**) and tabulated in Tables 5.3.1.1 and 5.3.1.2 pp 77. Several denominators were identified as having the potential to be classified as both a contributor and a mitigator. This characteristic is also recorded in these tables.

Table 5.3.1.1 Denominators Relative to Age Groups.

Denominator	Age Grp 1	Age Grp 2	Age Grp 3	Age Grp 4	Age Grp 5
Level of Supervision	**C**	**C**	**C,M**	**C**	-
Supervision Adequate	**M**	**C**	**C**	-	-
Trained for Task	**M**	**C**	**M**	**M**	**M**
Refresher Training	**M**	**C**	**C**	**C**	**C**
Peer Training Only	-	**M**	**M**	**M**	**M**
Company Induction	**M**	**M**	**M,C**	**M**	**M**
Hazard ID and Control Training	**M,C**	**M**	**M**	**M**	**M**
Company Safety System Training	**M,C**	**M**	**M**	**C,M**	**M**
Very Experienced in this Task	**M**	**M,C**	**M**	**M**	**M**
Performed task Regularly	**M**	**M**	**M**	**C**	**M**
Ample Time	**M**	**C**	**M**	**M**	**M**
Legal requirements	**M**	**C**	**M**	**M**	**M**
Complied	**M**	**C**	**M**	**M**	**M**
Company Requirements	**M**	**C**	**M**	**M**	**M**
Complied	**M**	**C**	**M**	**M**	**M**
External Pressure	**M**	**M**	**M**	**M**	**M,C**
Fit For Work	**M**	**M**	**M**	**M**	**M**

Table 5.3.1.2 Denominators Relative to Age Groups.

Denominator	**Age Grp 1**	**Age Grp 2**	**Age Grp 3**	**Age Grp 4**	**Age Grp 5**
Cope with Roster	**M**	**M**	**M**	**M**	**M**
Length of Shift	**M**	**C**	**M**	**M**	**M**
Private Life Conflict	**M**	**M,C**	**C**	**C,M**	**M**
Internal Pressure	**C,M**	**C**	**M**	**M**	**M**
Confident	**M**	**M**	**M**	**M**	**M**
Work Within Skills	**M**	**C**	**M**	**M**	**M**
Complacent	**M**	**M**	**M**	**M**	**M**
Will Not Violate	**M**	-	**M**	**M**	**M**
Will Not Take Short Cuts	**M**	**M**	**M**	**M**	**M**
Ignore Peer Breaches	**C,M**	**M**	**M**	**M**	**M**
Fear of Job Loss	**M**	**M,C**	**M**	**M**	**M**
Impress Management	**M**	**C**	**M**	**M**	**M**
Morale High	**M**	**M**	**M**	**M**	**M**
Ignore Peer Safety Breeches	**M**	**M**	-	**M**	-
Healthy Lifestyle	**M**	**C**	-	**M**	**M**
Trust in Management	**M**	**M**	**M**	**M**	**M**

6.0 CONCLUSION AND RECOMMENDATIONS

6.1 Conclusions:

Conclusions from this study are derived from information collected regarding the two major components of the construct model in terms of input and outputs of accidents. Elements comprising input criteria have been defined as denominators and outputs have been expressed in terms five output types; energy Exchange Involved, Body Part Affected, Severity of Injury, Damage Type and Industry Type.

6.2 Research Questions Answered:

All research questions are answered in terms of input and output data collected under the guidelines of this reports theoretical framework. As such inputs to accidents are described in terms of significant denominators, not in terms of unsafe acts and conditions. Accident output details and causative agents are also not discussed. Output details are discussed in line with the procedure outlined in the theoretical framework.

Are younger, inexperienced workers subjected to more serious accidents than older groups in the work place?

The accident output section of this study has evaluated accident outcomes as relative to the age groups comprising the Port Hedland sample. Severity of injury was classed as Permanent, Temporary or Minor as per Kahler and Ellis, pp 14.

Figure 5.2.3 pp 75 demonstrates the severity of injury did not vary across the age groups for all three classifications. Also permanent injuries accounted for less than 10% of all injuries sustained across the age groups. Therefore it is evident that very few injuries experienced from this sample suffered a serious injury. Temporary and minor injuries accounted for the remainder and were fairly equally shared across the age groups. There was no indication that any one age group suffered more serious injury than any other group and that younger, inexperienced workers are not subjected to more serious accidents than the older groups.

Do accident characteristics in terms of output denominators stabilise or destabilise in older age groups?

In terms of this question, de-stabilize refers to a resurgence of contributing denominators inputting to an accident to affect a reoccurrence of a particular accident, that had been previously stabilized. As previous accident statistics for all age groups was not available, de-stabilizing cannot be assessed in these terms. Stability can only be assessed with comparison to the other age group performances. Figures 5.2.1 to 5.2.5 pp 73 - 75 do not reveal any information suggesting a destabilizing trend in the older work groups, nor do they suggest the contrary. Therefore the original concept of determining if complacency or some other agency had caused resurgence cannot be determined. This represents a limitation to the study.

Do inputs to accidents vary across age groups?

Inputs to accidents experienced across the age groups were found to vary, revealing specific characteristics.

Age group 1 identified significant contributing denominators as Supervision, Hazard Identification and Control, Internal Pressure, Training in the Company Safety System and subject to Peer Pressure. These denominators were primarily unique to this age group.

Age Group 2 data indicated that this group was impacted by fifteen different contributing denominators, more than twice the number than any other age group. They were mainly focussed on issues of Training, Supervision, Complying with Rules, Working within Skill Levels, Length of Shift and Unhealthy Lifestyle.

Age Group 3 also identified Training as a significant denominator along with Conflict with Lifestyle and Supervision as the only three significant contributing denominators for this group.

Age Group 4 also identified Supervision, Training and Private Life Conflict as significant contributing denominators.

Age Group 5 revealed Refresher Training as a key issue for them along with External Pressures.

Even though this study has revealed that accident inputs do vary across age groups and that information specific to the identified denominators may be useful in suggesting corrective foci, the most common significant denominators were mitigators.

Do the outputs of accidents vary across age groups?

Contrary to the variations identified associated with accident inputs; accident outputs were relatively constant across the age groups with a few exceptions. Figure 5.2.1 pp73 indicates that the energy exchanges involved for the majority of accidents were:

Machine energy - Age Group 1 received approximately twice as many injuries as the other four groups, who all displayed similar frequencies.

Electrical energy - Age Groups 1 and 2 scored highest at 20% and 33% respectively. The remaining groups were found to have similar, lower scores.

Gravitational energy - Mainly impacted the oldest two groups scoring frequencies of 17% and 30% respectively.

Susceptible part - Where a low energy impact is received to a sensitive body part, Age Group 1 scored much higher than any other group with a frequency of 33%

Human energy - Is the most significant energy exchange resulting in affecting all age groups significantly.

Body Part Affected - Figure 5.2.2 pp 74 indicates hand and back injuries are the most prevalent across all age groups. Frequencies indicate that back injuries are also prevalent among younger workers as well, with all age groups being affected.

Severity of Injury and **Damage Type -** (Figures 5.2.3 and 5.2.4 pp 74 - 75) did not display any significant characteristic with regards to age distribution, with all groups affected in a similar manner. However, most damage type resulted from a single traumatic energy exchange to some part of the body.

This report did identify variations in accident output across the age groups. Potentially the most significant variation being predominance for human energy to be involved in injuries, with the back being the body part most affected.

Conclusions and Recommendations Relative to Findings:

The “at most risk” group was not identified as Age Group 1, as suggested by the literature review. Age Group 1 of this sample appear to be well managed and under an appropriate safety management system. Only four significant contributing denominators impacting their accidents were identified.

These denominators were grouped into two themes; training and supervision. Potentially the most significant being lack of hazard identification training. These two themes were identified in the literature review as significant inputs involving accidents and young workers and appear not yet adequately controlled.

Age Group 2 emerged as the age group most at risk. It was impacted by a larger proportion of significant contributing denominators than any other group. However, Age Group 2 experienced few permanent injuries, in line with the other age groups. Supervision and training were not significant contributors to their accidents, whereby new starters in Age Group 1 do appear to be catered for appropriately in terms of training and supervision. Age Group 2 displayed a shift in frequency scores and the number of significant denominators impacting their accidents. Supervision and training had decreased for this group, as they had been in the workforce for a significant time. They were less liable to comply with rules and were prepared to work outside their skill levels. It is theorized that once workers had been in the workforce a few years, management potentially perceived these workers were now skilled enough for them to reduce the levels of training and supervision. This appears to be reasonable, however members of this group are being injured on tasks they had not been trained for, indicating workers or supervision were potentially over estimating skill levels. Or, potentially, training and supervision efforts were underestimated or decreased too quickly.

Hazard identification skills are perhaps the most important safety skill to acquire. To be able to effectively identify hazards, effect appropriate controls and assess residual risk levels are basic skills to ensure a worker's safety. Age Group 1 marked hazard identification as a significant contributor to their accidents. All other groups did not, indicating that the training effort expended on young workers in this regard is potentially successful.

If the training effort and supervision levels are decreased too quickly after the first year of a new worker's employment, there may be a risk that continued development of desired safety and task skills may come under the influence of peer training effects. Good peers can be valuable in continuing to foster desired behaviour for little financial outlay, whereby other peers may serve to weaken established preferred behaviour.

Peer training is potentially an essential component of the workplace learning process, but it should not take the place of refresher and other formal training courses.

The severity of injuries did not trend across age groups. Instead all age groups scored fairly consistently. Figure 5.2.3 pp 74 indicated most injuries were temporary and minor with few Permanent injuries reported. With most injuries classified as temporary and minor, it could be concluded that these workers are identifying and managing the more serious hazards but still have work to do in reducing the minor injuries.

However, there was some trending reported. The most prevalent body part affected was the back and the most common energy exchange was human energy. All age groups were affected, suggesting that ergonomic issues may be impacting workers of all industries involved. Figure 5.2.2 pp 74 indicates hand injuries as being a significant output from accidents; being the most prevalent injuries sustained. Once again, all age groups being affected, however, Age Groups 1, 2 and 3 were the most affected. Older workers were subjected to injuries involving gravitational energy. There was not enough data to determine if they tripped or fell some distance. It could be expected older workers may be more susceptible to trips and falls than younger workers. However, this was not determined. Figure 5.2.3 pp 74 indicates that most injuries are not permanent and mostly temporary or minor indicating the gravitational energy exchanges may have resulted from slips and trips, not major falls.

Most of the contributing denominators identified were assigned a composite status. Therefore while they exhibited a negative effect they also displayed a positive effect. This finding is indicative that across industry, safety systems are working; they potentially only need improving. This concept is supported by over 90% of the denominators being mitigators. This proportion represents a significant indicator that considerable effort is being expended towards safety improvement. If mitigators are an indicator of what industry is doing right, then mitigators deserve proportional attention in safety management systems. Traditionally, negative issues and trailing indicators received attention and it is theorized that a “blame and punish” strategy existed in the recent past. A mitigator-based focus could potentially reverse these trends by assisting to develop and initiate a “positive focus” safety management plan.

6.3 Recommendations to Participating Industries:

Recommendations made are based on findings from this report. These suggestions will be made available to the participating industries to augment current safety management systems.

Focus on Hazard Identification has been identified in the report as a significant contributor to accidents in some age groups. The capacity for an individual or group to successfully identify hazards and apply appropriate controls is an essential component of their workplace safety. It is suggested that hazard identification be incorporated as a part of the safety plan.

This report determined the highest impacting acting denominators were mitigators, suggesting that the companies involved in this study already have a sound safety management system in place. It is recommended that once identified, mitigating denominators should be reinforced and fostered as an integral component of their safety management system. A positive based system should identify and focus on leading indicators to determine appropriate strategies of continuous improvement rather than focussing on trailing indicators, after an accident has occurred.

The focus of this report was primarily aimed at work related groups, in this case, age groups. An understanding of the group dynamics of individual teams (industries) is potentially useful in assessing safety management strategies. However, a total focus on the group is not recommended as accident denominators act on both groups and individuals.

Ergonomics and hand injuries are still a real issue as identified by this report. It is recommended that safety management systems should still incorporate strategies aimed at minimising these injuries as it is theorized it will require a concerted effort to reverse these trends.

It is recommended that a wider application of these findings may be extended to other heavy industries of the Port Hedland area. There is not enough evidence to suggest these findings deserve further application.

6.4 Suggestions for Future Research:

Suggestions for further research arising from this study are:

1) The dynamics of workplace and personal denominators and their potential to affect the physical and mental aspects of worker safety.
2) Use of positive indicators to drive safety systems.
3) The effects of personal and contributing denominators upon age groups with regards to complacency and misjudged confidence.
4) Supervision levels and method effectiveness as workers gain experience.
5) Specific task training and assumed competencies.
6) The dynamic effects of peer training appear to be poorly understood by workers and management.
7) Company induction processes, effectiveness and consequent flow-on effects appear to be more ceremonial than functional.
8) Methodology and effectiveness of hazard identification, implementation of control measures and assessment of risk.
9) Effectiveness of training in company safety systems as a safety management tool.
10) Worker understanding and awareness of workplace legal requirements appears to be poorly understood.
11) The extent and effects of internal pressures placed upon workers appears to be evident in most industries exhibiting a negative impact on safety performance of affected workers.
12) There appears to be an industry specific distrust in management with a flow on negative impact on safety performance.
13) The concept of a mitigator based management system requires further research.

7.0 APPENDICES

Table 7.1 (a) Instrument for Collecting Accident Output Data

#	Energy Exchange		Severity of Injury		Damage Type		Industry Type	
1	Machine Energy		Permanent Damage		Single Traumatic Energy Exchange		Mining	
2	Thermal energy		Temporary Damage		Series of Exchanges		Engineering	
3	Electrical Energy		Minor		Continuous Small Exchanges		Construction	
4	Vibration Energy						Manufacture	
5	Radiation Energy						Electrical	
6	Gravitational						Other	
7	Noise Energy							
8	Susceptible Part							
9	Specialised Shape							
10	Vehicular							
11	Human							
12	Other							

Table 7.1 (b) Instrument for Collecting Accident Output Data

#	Body Part Affected		#	Body Part Affected		#	Body Part Affected	
1	Abdominal Area		15	Eyes		29	Multiple injuries (list all codes)	
2	Ankle left		16	Face		30	Neck	
3	Ankle Right		17	Foot left		31	Nose	
4	Arm left		18	Foot right		32	Ribs	
5	Arm right		19	Hand left		33	Shin left	
6	Back lower		20	Hand right		34	Shin right	
7	Back middle		21	Head		35	Shoulder left	
8	Back upper		22	Hips		36	Shoulder right	
9	Buttocks		23	Knee left		37	Teeth	
10	Chest		24	Knee right		38	Throat	
11	Ear left		25	Leg left (upper)		39	Toes left	
12	Ear right		26	Leg right (upper)		40	Toes right	
13	Elbow left		27	Leg left (lower)		41	Wrist left	
14	Elbow right		28	Leg right (lower)		42	Wrist right.	

Table 7.2 Instrument for Collecting Accident Construct Data

Table 3						
WORKPLACECONTRIBUTING DENOMINATORS/MITIGATORS						
1.0	**Supervision:**					
1.1	You were required to have some level of supervision for this task	1	2	3	4	5
1.2	Supervision was adequate	1	2	3	4	5
2.0	**Training:**					
2.1	You were adequately trained for this task	1	2	3	4	5
2.2	You received adequate refresher training	1	2	3	4	5
2.3	You have received peer training only	1	2	3	4	5
2.4	The company induction process is too general	1	2	3	4	5
2.5	You have had effective hazard identification and control training	1	2	3	4	5
2.6	You have been trained in the Company Safety Management System	1	2	3	4	5
3.0	**Experience:**					
3.1	You are very experienced at performing this task	1	2	3	4	5
3.2	You perform this task regularly	1	2	3	4	5
3.3	You had ample time to complete the job safely	1	2	3	4	5
4.0	**Legislative Compliance:**					
4.1	You are aware of all legal requirements for this task	1	2	3	4	5
4.2	You complied with these requirements	1	2	3	4	5
5.0	**Company Rules Compliance:**					
5.1	You are aware of all Company requirements for this task	1	2	3	4	5
5.2	You complied with these requirements	1	2	3	4	5
6.0	**Other:**					
6.1	You were under no external pressure of a private nature	1	2	3	4	5
6.2	You were fit for work at the time of the accident	1	2	3	4	5
6.3	You are able to cope with your shift roster	1	2	3	4	5
6.4	The length of each shift is just right	1	2	3	4	5
6.5	Work hours do not conflict with your private life	1	2	3	4	5
6.6	No internal pressure from management to get jobs done.	1	2	3	4	5
PERSONAL CONTRIBUTING DENOMINATORS/MITIGATORS						
7.1	You are very confident in performing this task	1	2	3	4	5
7.2	You always work within competency and skill levels	1	2	3	4	5
7.3	You were not complacent at the time of your accident	1	2	3	4	5
7.4	You are not willing to violate rules	1	2	3	4	5
7.5	You are not willing to take short cuts	1	2	3	4	5
7.6	You are not afraid of peers	1	2	3	4	5
7.7	There was no fear of job loss at the time	1	2	3	4	5
7.8	You were not trying to impress management	1	2	3	4	5
7.9	Your morale was high at the time of the accident	1	2	3	4	5
7.10	You are not prepared to ignore safety breaches by peers	1	2	3	4	5
7.11	You maintained a healthy life style	1	2	3	4	5
7.12	You trusted management	1	2	3	4	5

Table 7.3 Denominator Scores By Age Group

	Age Grp 1			Age Grp 2			Age Grp 3			Age Grp 4			Age Grp 5		
Denominator	**C**	**U**	**M**	**C**	**U**	**M**	**C**	**U**	**M**	**C**	**U**	**M**	**C**	**U**	**M**
Supervision Required	53.3	13.3	33.4	46.7	3.3	50.0	76.6	3.3	20.0	90.0	3.3	6.7	90.0	0	10.0
Supervision Adequate	23.3	13.3	53.3	46.6	33.3	20.0	20.0	53.3	26.7	43.3	46.7	10.0	13.3	53.3	33.3
Trained for Task	20.0	0	80.0	63.3	0	36.6	13.3	30.0	56.7	0	10.0	90.0	6.7	23.3	70.0
Refresher Training	20.0	6.7	73.3	70.0	6.7	23.3	56.7	20	23.3	73.3	20	6.7	60.0	26.7	13.0
Peer Training Only	10.0	16.7	73.4	10.0	50.0	40.0	26.6	30.0	43.4	33.4	16.6	50.0	36.7	40.0	23.4
Induction Too General	26.6	0	73.4	33.3	6.7	60.0	40.0	20.0	40.0	3.3	26.7	70.0	20.0	36.7	43.4
Hazard ID and Control Training	43.3	6.7	60.0	23.3	0	73.7	23.4	3.3	73.3	0	6.7	93.3	6.7	0	93.3
Company Safety System Training	40.0	6.7	53.6	33.3	6.7	60.0	16.7	13.3	70.0	60.0	0	40.0	6.7	0	93.3
Very Experienced in this Task	26.7	10.0	63.3	43.4	3.3	53.3	0	3.3	96.7	20.0	0	80.0	13.3	0	86.7
Performed this task Regularly	23.3	3.3	73.3	36.7	23.3	40.0	3.3	3.3	93.4	53.4	20	26.6	36.6	0	63.4
Ample Time	30.0	13.3	56.7	66.7	3.3	30.0	26.7	0	73.3	3.3	6.7	90.0	23.3	0	76.7
Legal requirements	26.7	16.7	56.6	60.0	26.7	13.3	33.3	26.7	40.0	16.7	20.0	63.3	16.7	20.0	63.7
Complied	20.0	23.3	56.7	70.0	16.7	13.3	20.0	40.0	40.0	16.7	33.3	50.0	6.7	30	63.3
Company Requirements	20.0	6.7	73.3	73.3	0	26.7	13.3	3.3	83.4	0	3.3	96.7	0	0	100
Complied	13.3	13.3	73.4	46.7	26.7	26.6	13.3	16.7	70.0	16.7	0	83.3	16.7	6.7	76.6
No External Pressure	10.0	13.3	76.6	23.3	23.3	53.4	26.7	16.7	56.6	26.7	13.3	60.0	43.3	20.0	46.7
Fit For Work	0	7.6	93.3	0	0	100	0	0	100	0	0	100	0	0	100
Cope with Roster	20.0	0	80.0	6.7	23.3	70.0	3.3	16.7	80.0	6.7	6.7	86.6	13.3	0	86.7
Length of Shift	26.7	0	73.3	66.7	3.3	30.0	30.0	10.0	60.0	10.0	16.7	73.3	23.3	0	76.7
Private Life Conflict	16.6	6.7	76.7	43.3	0	56.7	70.0	0	30.0	46.7	10	43.3	33.3	0	66.7
Internal Pressure	53.3	0	46.7	76.7	3.3	20.0	36.7	0	66.3	10.0	16.7	43.3	23.3	0	76.7
Confident	6.7	6.7	86.6	3.3	0	96.7	0	0	100	0	3.3	96.7	0	0	100
Work Within Skills	13.3	0	86.7	60.0	3.3	36.7	23.3	0	76.7	0	20.0	80.0	20.0	10.0	70.0
Complacent	0	40.0	60.0	26.7	33.3	40.0	20.0	6.7	73.3	0	0	100	13.3	0	86.7
Will Not Violate	10.0	40.0	50.0	23.3	50.0	26.7	36.7	3.3	60.0	3.3	10.0	86.7	13.3	6.7	80.0
Will Not Take Short Cuts	10.0	16.7	73.3	26.7	30.0	43.3	36.7	16.7	46.6	20.0	16.7	63.3	26.6	16.7	56.7
Not Afraid of Peers	60.0	0	40.0	3.3	26.7	70.0	20.0	0	80.0	0	0	100	0	0	100
Fear of Job Loss	20.0	0	80.0	46.7	3.3	50.0	6.7	13.3	80.0	0	0	100	0	0	100
Impress Management	20.0	13.3	56.7	43.3	20.0	36.6	0	0	100	6.7	10.0	83.3	0	0	100
Morale High	0	16.7	83.3	6.7	23.3	70.0	6.7	36.7	56.6	6.7	40.0	53.3	0	33.3	66.7
Ignore Peer Safety Breaches	6.7	20.0	73.3	26.6	30.0	43.3	20.0	43.3	36.7	10.0	13.3	76.7	26.7	40.0	33.3

Healthy Lifestyle	13.3	6.7	80.0	60.0	13.3	26.7	20.0	43.3	36.7	10.0	40.0	50.0	30.0	26.7	43.3
Trust in Management	0	26.7	73.3	23.4	33.3	43.3	36.7	20.0	43.3	10.0	40.0	50.0	50.0	6.7	43.3

Table 7.5 Energy Exchange Involved Data

Age Group			Frequency	Percent	Valid Percent	Cumulative Percent
15 to 24 years	Valid	Machine Energy	6	20.0	20.0	20.0
		Electrical Energy	6	20.0	20.0	40.0
		Gravitational Energy	3	10.0	10.0	50.0
		Susceptible Part	1	3.3	3.3	53.3
		Specialized Shape	4	13.3	13.3	66.7
		Human Energy	8	26.7	26.7	93.3
		Chemical	2	6.7	6.7	100.0
		Total	30	100.0	100.0	
25 to 34 years	Valid	Machine Energy	3	10.0	10.0	10.0
		Electrical Energy	4	13.3	13.3	23.3
		Radiation Energy	1	3.3	3.3	26.7
		Gravitational Energy	3	10.0	10.0	36.7
		Noise Energy	1	3.3	3.3	40.0
		Susceptible Part	3	10.0	10.0	50.0
		Specialized Shape	5	16.7	16.7	66.7
		Human Energy	10	33.3	33.3	100.0
		Total	30	100.0	100.0	
35 to 44 years	Valid	Machine Energy	3	10.0	10.0	10.0
		Thermal Energy	2	6.7	6.7	16.7
		Electrical Energy	10	33.3	33.3	50.0
		Vibration Energy	1	3.3	3.3	53.3
		Radiation Energy	1	3.3	3.3	56.7
		Gravitational Energy	1	3.3	3.3	60.0
		Susceptible Part	1	3.3	3.3	63.3
		Specialized	3	10.0	10.0	73.3

		Shape				
		Vehicular Energy	2	6.7	6.7	80.0
		Human Energy	5	16.7	16.7	96.7
		Chemical	1	3.3	3.3	100.0
		Total	30	100.0	100.0	
45 to 54 years	Valid	Machine Energy	3	10.0	10.0	10.0
		Electrical Energy	4	13.3	13.3	23.3
		Vibration Energy	1	3.3	3.3	26.7
		Radiation Energy	2	6.7	6.7	33.3
		Gravitational Energy	5	16.7	16.7	50.0
		Susceptible Part	5	16.7	16.7	66.7
		Specialized Shape	2	6.7	6.7	73.3
		Human Energy	8	26.7	26.7	100.0
		Total	30	100.0	100.0	
55 to 64 years	Valid	Machine Energy	3	10.0	10.0	10.0
		Electrical Energy	4	13.3	13.3	23.3
		Radiation Energy	1	3.3	3.3	26.7
		Gravitational Energy	9	30.0	30.0	56.7
		Susceptible Part	3	10.0	10.0	66.7
		Specialized Shape	1	3.3	3.3	70.0
		Vehicular Energy	1	3.3	3.3	73.3
		Human Energy	7	23.3	23.3	96.7
		Biological	1	3.3	3.3	100.0
		Total	30	100.0	100.0	

Table 7.6 Body Part Affected Data

Age Group			Frequency	Percent	Valid Percent	Cumulative Percent
15 to 24 years	Valid	Ankle Left	1	3.3	3.3	3.3
		Arm Right	2	6.7	6.7	10.0
		Back Lower	5	16.7	16.7	26.7
		Chest	1	3.3	3.3	30.0
		Elbow Left	1	3.3	3.3	33.3
		Eyes	2	6.7	6.7	40.0
		Face	1	3.3	3.3	43.3
		Hand Left	4	13.3	13.3	56.7
		Hand Right	7	23.3	23.3	80.0
		Head	2	6.7	6.7	86.7
		Knee Right	1	3.3	3.3	90.0
		Leg Left (upper)	1	3.3	3.3	93.3
		Shin Right	2	6.7	6.7	100.0
		Total	30	100.0	100.0	
25 to 34 years	Valid	Ankle Right	1	3.3	3.3	3.3
		Arm Left	1	3.3	3.3	6.7
		Back Lower	5	16.7	16.7	23.3
		Back Middle	1	3.3	3.3	26.7
		Back Upper	1	3.3	3.3	30.0
		Ear Right	1	3.3	3.3	33.3
		Eyes	2	6.7	6.7	40.0
		Face	1	3.3	3.3	43.3
		Foot Right	2	6.7	6.7	50.0
		Hand Left	5	16.7	16.7	66.7
		Hand Right	5	16.7	16.7	83.3
		Knee Left	1	3.3	3.3	86.7
		Knee Right	1	3.3	3.3	90.0
		Leg Left (lower)	1	3.3	3.3	93.3
		Leg right (lower)	1	3.3	3.3	96.7
		Neck	1	3.3	3.3	100.0
		Total	30	100.0	100.0	
35 to 44 years	Valid	Ankle Left	1	3.3	3.3	3.3
		Ankle Right	1	3.3	3.3	6.7
		Arm Left	2	6.7	6.7	13.3
		Arm Right	2	6.7	6.7	20.0
		Back Lower	5	16.7	16.7	36.7
		Chest	1	3.3	3.3	40.0
		Ear Left	1	3.3	3.3	43.3
		Elbow Left	1	3.3	3.3	46.7
		Face	3	10.0	10.0	56.7
		Foot Left	1	3.3	3.3	60.0
		Hand Left	3	10.0	10.0	70.0
		Hand Right	7	23.3	23.3	93.3
		Head	1	3.3	3.3	96.7

		Shoulder Right	1	3.3	3.3	100.0
		Total	30	100.0	100.0	
45 to 54 years	Valid	Abdominal Area	1	3.3	3.3	3.3
		Ankle Right	1	3.3	3.3	6.7
		Arm Left	1	3.3	3.3	10.0
		Back Lower	5	16.7	16.7	26.7
		Back Middle	3	10.0	10.0	36.7
		Chest	1	3.3	3.3	40.0
		Ear Left	1	3.3	3.3	43.3
		Eyes	1	3.3	3.3	46.7
		Face	2	6.7	6.7	53.3
		Hand Left	2	6.7	6.7	60.0
		Hand Right	4	13.3	13.3	73.3
		Head	1	3.3	3.3	76.7
		Knee Left	2	6.7	6.7	83.3
		Leg Left (upper)	1	3.3	3.3	86.7
		Leg right (lower)	1	3.3	3.3	90.0
		Neck	1	3.3	3.3	93.3
		Shoulder Right	1	3.3	3.3	96.7
		Wrist Right	1	3.3	3.3	100.0
		Total	30	100.0	100.0	
55 to 64 years	Valid	Not Classified	1	3.3	3.3	3.3
		Ankle Left	3	10.0	10.0	13.3
		Ankle Right	1	3.3	3.3	16.7
		Arm Right	3	10.0	10.0	26.7
		Back Lower	4	13.3	13.3	40.0
		Back Middle	1	3.3	3.3	43.3
		Chest	2	6.7	6.7	50.0
		Elbow Left	1	3.3	3.3	53.3
		Eyes	1	3.3	3.3	56.7
		Face	1	3.3	3.3	60.0
		Hand Left	1	3.3	3.3	63.3
		Hand Right	3	10.0	10.0	73.3
		Head	1	3.3	3.3	76.7
		Knee Right	1	3.3	3.3	80.0
		Leg Left (upper)	1	3.3	3.3	83.3
		Neck	1	3.3	3.3	86.7
		Shin Left	2	6.7	6.7	93.3
		Shoulder Left	1	3.3	3.3	96.7
		Wrist Right	1	3.3	3.3	100.0
		Total	30	100.0	100.0	

Table 7.7 Severity of Injury Data

Age Group			Frequency	Percent	Valid Percent	Cumulative Percent
15 to 24 years	Valid	Permanent Damage	3	10.0	10.0	10.0
		Temporary Damage	14	46.7	46.7	56.7
		Minor	13	43.3	43.3	100.0
		Total	30	100.0	100.0	
25 to 34 years	Valid	Permanent Damage	3	10.0	10.0	10.0
		Temporary Damage	15	50.0	50.0	60.0
		Minor	12	40.0	40.0	100.0
		Total	30	100.0	100.0	
35 to 44 years	Valid	Permanent Damage	2	6.7	6.7	6.7
		Temporary Damage	11	36.7	36.7	43.3
		Minor	17	56.7	56.7	100.0
		Total	30	100.0	100.0	
45 to 54 years	Valid	Permanent Damage	1	3.3	3.3	3.3
		Temporary Damage	15	50.0	50.0	53.3
		Minor	14	46.7	46.7	100.0
		Total	30	100.0	100.0	
55 to 64 years	Valid	Permanent Damage	2	6.7	6.7	6.7
		Temporary Damage	14	46.7	46.7	53.3
		Minor	14	46.7	46.7	100.0
		Total	30	100.0	100.0	

Table 7.8 Damage Type Data

Age Group			Frequency	Percent	Valid Percent	Cumulative Percent
15 to 24 years	Valid	Single Traumatic Energy Exchange	29	96.7	100.0	100.0
	Missing Total	System	1	3.3		
		Total	30	100.0		
25 to 34 years	Valid	Single Traumatic Energy Exchange	26	86.7	86.7	86.7
		Series of Exchanges	2	6.7	6.7	93.3
		Continuous Small Exchanges	2	6.7	6.7	100.0
		Total	30	100.0	100.0	
35 to 44 years	Valid	Single Traumatic Energy Exchange	24	80.0	80.0	80.0
		Series of Exchanges	5	16.7	16.7	96.7
		Continuous Small Exchanges	1	3.3	3.3	100.0
		Total	30	100.0	100.0	
45 to 54 years	Valid	Single Traumatic Energy Exchange	25	83.3	83.3	83.3
		Series of Exchanges	5	16.7	16.7	100.0
		Total	30	100.0	100.0	
55 to 64 years	Valid	Single Traumatic Energy Exchange	28	93.3	93.3	93.3
		Series of Exchanges	2	6.7	6.7	100.0
		Total	30	100.0	100.0	

Table 7.9 Industry Type Data

Age Group			Frequency	Percent	Valid Percent	Cumulative Percent
15 to 24 years	Valid	Mining	9	30.0	30.0	30.0
		Engineering	11	36.7	36.7	66.7
		Construction	7	23.3	23.3	90.0
		Manufacturing	1	3.3	3.3	93.3
		Electrical	2	6.7	6.7	100.0
		Total	30	100.0	100.0	
25 to 34 years	Valid	Mining	13	43.3	43.3	43.3
		Engineering	7	23.3	23.3	66.7
		Construction	5	16.7	16.7	83.3
		Manufacturing	1	3.3	3.3	86.7
		Electrical	4	13.3	13.3	100.0
		Total	30	100.0	100.0	
35 to 44 years	Valid	Mining	21	70.0	70.0	70.0
		Engineering	3	10.0	10.0	80.0
		Construction	3	10.0	10.0	90.0
		Electrical	3	10.0	10.0	100.0
		Total	30	100.0	100.0	
45 to 54 years	Valid	Mining	22	73.3	75.9	75.9
		Engineering	4	13.3	13.8	89.7
		Construction	2	6.7	6.9	96.6
		Electrical	1	3.3	3.4	100.0
		Total	29	96.7	100.0	
		System	1	3.3		
		Missing Total	30	100.0		
55 to 64 years	Valid	Mining	23	76.7	76.7	76.7
		Engineering	1	3.3	3.3	80.0
		Construction	5	16.7	16.7	96.7
		Electrical	1	3.3	3.3	100.0
		Total	30	100.0	100.0	

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