Evaluation of effectiveness of the working at heights training in New Zealand

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Abstract

Around 2.5 million New Zealanders go to work every day meaning that for a majority of the New Zealanders, being at work constitutes a considerable part of their lives. Therefore, the health and safety of the employees at work is of utmost importance. Among many professions in New Zealand, the construction industry is thriving and it also involves "working at heights". Unfortunately, construction and other working at heights professions are risk prone since a large number of deaths and injuries of the workers are reported every year. Although a majority of the workers undergo training, the industry is still plagued by significantly large number of accidents and deaths. This study therefore, examined the effectiveness of the working at heights training. Specifically, the study addressed how effective the training was in improving the employee safety knowledge, behaviour, risk acceptance, confidence, commitment and work practices. Furthermore, the training was also evaluated for its ability to reduce some of the hindrance factors and to improve on the facilitating factors.

This study adopted a cross-sectional design utilising the self-reported data from 429 participants aged 15 to 64 years. The participants included the pre-training cohort with no prior working at heights training (Pre-training) or the workers who had undergone training (Post-training) 6 Months or 12 Months or 24 Months prior to the survey. The results of the current study illustrate that the training significantly improves the safety knowledge and safety climate and reduces the risky behaviour and personal hindrance factors. In addition, the results suggest that the safety knowledge and other aspects of the safety climate and attitude would be retained even after 2 years of the training (24 Months). Comparison of the results between the pre and post-training surveys indicates that the training is effective in improving the safety knowledge of working at heights. Among the safety climate parameters, the training was proven to be effective in significantly improving the safety behaviour, confidence and safety commitment. The training is found to be effective in reducing the risk acceptance behaviour,

and improving the employee work practices. In addition, the survey results clearly indicate that the management provides full support and backs the implementation of the safety regulations with resources. Finally, the survey confirms that the training is very effective in reducing the personal hindrance factors and improving co-worker relationship factors. Collectively, the results from the current study confirm that the training is effective in improving the safety knowledge, behaviour and safety climate.

The implications of the findings of the current study are several. The results imply that VHNZ working at heights training is successful in imparting confidence in the workers so that they could stop co-workers from taking risks and therefore reduce injuries and improve the safety record. The results implicate that, for improving the safety record of the employees, it is essential to offer job specific safety training rather than a generic health and safety training. The study results indicate that "refresher training" is essential for the long term retention of the safety knowledge and behaviour. Therefore, one of the implications for VHNZ is to come up with standard guidelines for the "periodicity" of the refresher training and provide that at appropriate times.

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List of Figures

List of Tables

List of Abbreviations

ACC	Accident Compensation Corporation
BP	British Petroleum
GDP	Gross Domestic Product
HRM	Human Resource Management
HSE	Health and Safety Executive
KSA	knowledge, new skill sets and attitudes
MBIE	Ministry of Business, Innovation and Employment
NZQA	New Zealand Qualifications Authority
OSHA	Occupational Safety and Health Administration
PCBU	Person Conducting a Business or Undertaking
PPE	Personal Protective Equipment
RCT	Randomized Controlled Trial
RE	Realistic Evaluation
RTK	Right To Know
UK	United Kingdom
USA	United States of America
VH	Vertical Horizonz
VHNZ	Vertical Horizonz New Zealand

1 Table of Contents

Chapter One: Introduction

It is estimated that around 2.5 million people go to work every day in New Zealand and therefore, never before in the history of New Zealand, the health and safety has been so closely scrutinized. Some of the common work places in New Zealand include, homes, construction sites, office buildings, farms, manufacturing industries, mining sites, fishing vessels, boats, automobiles and aircrafts. With such a diverse work place and work force, it is not surprising that each year thousands of New Zealanders are either killed, injured or exposed to work related diseases such as Asthma or muscle and skeletal related diseases and even cancer. The Taskforce on the Health and Safety concluded that one in 10 workers in New Zealand is in some way harmed at a place of work and therefore, the estimates show that there were about 200,000 accident related claims amounting to 3.5 billion dollars in 2017 (Livingston, 2018).

1.1 Economic impacts of health and safety lapses

In 2011, the Department of Labour's State of Workplace Health and Safety published three different estimates of the cost of work-related injury ranging from $1.35 billion to $20.9 billion. The Ministry of Business, Innovation and Employment did further research and reported an estimated loss of NZ$1.0 billion as the cost of work related injury. This cost included $236 million for treatment and rehabilitation, $462 million of lost economic opportunities and $349 million as a loss of human costs. It was also estimated that work-related injury makes up 10% of the total costs of injury in New Zealand. The recent figures released by the WorkSafe show a worsening situation. The social and economic cost of deaths, injuries and ill-health arising from work is estimated at $3.5 billion a year. Every year it is estimated that 600-900 people die prematurely as a result of work-related ill-health and 50-60 people are killed in work related accidents. These are extraordinarily high numbers for a small country such as New Zealand. In addition to loss of life, there is always an economic cost of absenteeism. A recent workplace survey showed that close to 7.4 million workdays were lost through absenteeism in 2019 due

to illness and injury. This is a significant increase from 2016 which reported a loss of 6.7 million work days. Mathematical modelling suggested that the financial loss of absenteeism was estimated to be $1.79 billion across New Zealand in 2019. In 2016, the financial loss was found to be, $1.5 billion. Given these astonishing numbers, the WorkSafe has set a firm target to reduce workplace fatalities and injuries by 25% by 2020.

The construction sector (both residential and commercial) has had a significant growth in the last decade which resulted in enhanced employment in the construction industry in New Zealand. Fall from heights is a main cause of injuries and fatalities in the construction industry. Statistical analysis by the MBIE indicates that 50% of the falls are not actually from very great heights, rather they are from less than three metres height. Among these falls, around 70% of falls are reported as falls from ladders and roofs. The economic cost of the reported falls are estimated to be around $24 million a year and this does not include the human cost as a result of falls. In addition, the analysis indicates that the falls are significantly higher in less expected areas such as residential construction rather than industrial construction. Therefore, in New Zealand there is a huge economic cost due to falls and therefore, government is putting in massive efforts to mitigate the health and safety failures in the construction industry.

1.2 History of health and safety at work

Safety at work, also termed as "occupational safety" has been evolving for more than hundred years. The research showed that industrialization was a catalyst for the health and safety measures being implemented at work since unprecedented number of the workers started to work with machineries which led to injuries during this process. Legislation were introduced as early as 1800s to safe guard the employees and also improve the conditions in which the employees were working (Y.-H. Huang, Chen, & Grosch, 2010). Despite all these efforts, many workers did sustain injuries due to negligence by the employers and as a result the emphasis

shifted to the worker's compensation during 1900s. This gradually led to systematic studies of measuring and cataloguing various hazards at workplace (Y.-H. Huang et al., 2010). As a result of this pragmatic approach, many employers and industries started to take a holistic approach towards the health and safety by analysing various aspects of the work environment and there by simulating accidents to collect data. Furthermore, the data were used to plan the safety training to reduce accidents including injuries and fatalities. With the help of Psychologists, the health and safety field expanded to include the contribution of human behaviour and how it affected the safety performance. This enormous expansion in the field of occupation safety further led to the establishment of the government regulatory agencies dedicated to legislate, monitor and mitigate accidents (Hofmann, Burke, & Zohar, 2017). In the United Kingdom (UK) the regulatory agency is known as the Health and Safety Executive (HSE), while in the USA it is known as the Occupational Safety and Health Administration (OSHA). Here in New Zealand the responsibility rests with WorkSafe. The main responsibility of the regulatory authorities in their respective countries is to help in developing the health and safety legislation, provide guidelines for employees, employers, managers in their respective countries for safe working at work sites. As far as the research in health and safety is concerned, initial efforts were focused on the safety outcomes which again mainly focused on the accidents and injuries (Beus, Payne, Bergman, & Arthur, 2010; Hayes, Perander, Smecko, & Trask, 1998; Y.-H. Huang, Ho, Smith, & Chen, 2006). However, the research subsequently expanded to different aspects of safety at work namely the safety knowledge, safety behaviours, safety compliance, and safety participation by the employees (Clarke, 2006; Griffin & Curcuruto, 2016). Later on, further research saw the development of safety citizenship (Hofmann, Morgeson, & Gerras, 2003), safety motivation (Griffin & Neal, 2000) (Osman, Khalid, & Alfqeeh, 2019) management commitment (Beus et al., 2010) (Y.-H. Huang et al., 2006), employee engagement

(Hystad, Bartone, & Eid, 2014) (Nahrgang, Morgeson, & Hofmann, 2011) and other organisational factors (Ayim Gyekye, 2005; Barling, Kelloway, & Iverson, 2003).

1.3 Health and safety legislation in New Zealand

Although work place health and safety has attracted attention for many years, there was a comprehensive overhaul of the health and safety legislation which led to the 1992 Health and Safety act in New Zealand (New Zealand. Occupational & Health, 1992). However, the Pike River coal mine tragedy in 2010, increased fatalities in forestry industry and an increase in the accident rate at workplace resulted in a further review of the 1992 act and resulted in a new Health and Safety Act of 2015 (Schmidt-McCleave, 2019). The act was passed in August 2015 and implemented on April 4th, 2016. The 2015 Health and Safety Act closely resembles Australian Model Work Health and Safety Act with several additions that reflect New Zealand working environment.

The Health and Safety Act of 2015 focuses on the duty to manage risks in contrast to the focus on hazards in the 1992 Act. The act also introduces a new concept of "PCBU" which means a Person Conducting a Business or Undertaking. A PCBU can be an individual if someone is self-employed, or Director, Chief Executive or board of a company. In addition, the Act also introduces another new term "worker". This includes a broad range of individuals-employees, contractors and volunteer workers at the site of work. The act explicitly mentions that PCBU needs to take "reasonably practicable" steps to mitigate the risks and hazards. The 2015 Act also introduces several new key principles relating to the health and safety. One other significant improvement is that the Act provides better guidelines to the courts with regards to penalties since the act provides "three- tier hierarchy of the offences relating to the breach of health and safety duties, with a scale of penalties to address. The three hierarchies of penalties that are mentioned in the Act are as follows:

- At the top of the hierarchy, reckless conduct that exposes an individual to the risk of death or serious injury.
- In the middle of the hierarchy, a failure to comply with a health and safety duty where the failure exposes an individual to the risk of death or serious illness or injury.
- At the lowest level of the hierarchy, a failure to comply with a health and safety duty.

As compared to the 1992 Act, all three categories of offending carry significantly more penalties in the 2015 Health and Safety Act. In addition, the Act also provides regulators, such as safety inspectors, greater power to take action against the persons who are reasonably believed to be contravening.

1.4 Health and Safety in professions that involve working at heights

Working at heights is one of the most dangerous professions and it is commonly encountered in many professions such as construction, mining, window cleaning and airline industry. One of the major hazards/risks of working at heights is the fall from heights and it is seen commonly in industrialized countries such as USA (United States Department of Labor, (September 17, 2015) 2015), UK (Health and Safety Executive, 2014), Australia ("Fall protection takes centre stage at 3M's Fall Protection Open Day," 2016) and New Zealand (New Zealand. Statistics New, 2003). Studies have indicated that the fall from heights is a problem encountered world-wide and it accounted for 35% of the fatalities and 43% of major injuries in Singapore (Workplace Safety and Health Institute, 2016). Construction industry is a major contributor to the fall from heights in many countries. In addition to the loss of life and permanent disabilities, the fall from heights also affects economically. For example, Occupational Safety and Health Administration (OSHA) in USA estimates that each fall could cost between $50,000 to $100,000 in claims (OSHA, 2012) and this cost excludes direct and

indirect costs such as work stoppage, moral issues and personal costs. Therefore, fall prevention has been a top priority at the work sites by the management worldwide.

There are many professions in New Zealand that require proficiency of working safely at heights. Teetering way up hundreds of feet high above the sea level, wind turbine technicians are entrusted to install, test, repair, monitor and maintain electrical equipment. In addition to the wind turbine workers, utility pole workers, communication tower technicians and bridge painters all work at heights performing various tasks. The residential construction workers, workers involved in commercial buildings such as sky scrapers window cleaners also need to work at significant heights. Sky diving instructors, and mountaineering instructors also work at significant heights and are at risk of falling. Finally, the workers involved in forestry also work at significant heights. In the following section, risk factors for different working at height professions have been reviewed.

1.5 Hazards associated with construction industry

The major concern and hazard of working at heights is falling from heights or falling of objects placed at heights that can cause serious harm to the people below. Some of the tasks at the construction site which are associated with high risk for causing injuries are (i) erecting of the steel frame work of a big building (ii) erecting and dismantling of scaffolding (iii) working on ladders that are not properly secured (iv) roof cladding (v) dismantling of the machinery on the roof of a building (vi) welding performed at heights (v) fitting pipes and painting at heights. Main risk associated with many of these activities is falling from heights. This would result in multiple fractures or neck or spinal cord injuries or in the worst case fatalities. Another major risk associated with these activities are falling objects that in turn cause injuries. Depending on the weight of the falling objects and the vertical height, the falling objects can cause severe injuries including death, brain damage, broken bones or permanent disabilities.

Data collected suggest that in the construction industry, roof related activities are the main contributors toward accidents. The accidents at the roof occur during small repairs or maintenance work that include replacing new tiles, cleaning the gutters or chimneys.

Unprotected edges where people are working pose another major threat of working at heights. The unprotected edges are seen on roofs, elevated walkways, scaffolding and access platforms. If the edges are not properly guarded, that could lead to the fall of workers or tools and other equipment placed on the platforms resulting in injuries of individuals working underneath.

Unstable or poorly maintained access equipment such as ladders, scaffolding, platforms are another major source of accidents while working at heights. The access equipment that are not properly positioned, poorly constructed or secured are considered unstable.

1.6 Hazards associated with other professions that involve working at heights

The industrial wind turbines are around 100 meters tall. Therefore, during construction and/or maintenance work, the workers are exposed to more than 3 meters height and therefore to fall hazard (Atkinson, 2010). Another major risk factor for the wind turbine workers is chemical exposure.

Sky diving instructor is another profession that requires working at heights. One of the major risk factors in sky diving is the malfunction of parachute resulting in free fall and severe injury or death (Levingston, 2016). Another common risk factor encountered in sky diving is "hazardous attitude".

1.7 Training for working at heights in New Zealand

Training has been shown to reduce the accidents and deaths due to falls. WorkSafe is the primary regulator of work place health and safety in New Zealand (WorkSafe, 2020). Hence, WorkSafe is entrusted with providing the best practices to overcome falls from heights at work in New Zealand.

The WorkSafe guide lines as "Best Practices" for working at heights are in fact standard operating procedures to all the workers who work at heights in New Zealand (WorkSafe, 2020). In addition, these guidelines provide directions to the managers involved in planning and preparation of the health and safety protocols at the beginning stages of working at heights project. Since the best practice guidelines developed by WorkSafe are in line with the 2015 Health and Safety Act (Workplace Safety and Health Institute, 2016), implementing the guidelines at work site means that the organizations and workers have met their obligation and it can be used as an evidence in the court of law.

One common misconception when it comes to working at heights is the Regulation 21. The Regulation 21 of the Health and Safety Regulations deals with the "three- meter rule". The Regulation 21 is often misinterpreted that for the workers who are working at a height that is less than 3 meters in height, no controls are necessary. However, that interpretation is not correct. The Health and Safety act 2015 mandates that the rules need to be followed at any and all levels when there is a potential for a worker to fall from any height (Workplace Safety and Health Institute, 2016).

1.8 Best practices recommendations by WorkSafe for working at heights

Based on the extensive research work and legislative requirements of the Health and Safety Act 2015, WorkSafe recommended standard operating procedures for working at heights (WorkSafe, 2020). The research shows that many falls from heights in New Zealand are as a result of inadequate planning and organization of the work place. Therefore, the Best Practices recommendations include the following steps:

1. The hazards specific to the work site should be identified
2. The hazards assessed before the start of the work
3. Controlling measures of the hazards should be established

4. Approaches taken to mitigate risks should be monitored
5. Approaches taken should be documented

1.8.1 Identification of work site specific hazards

Hazards at work sites can be identified by many different ways. Firstly, walking around the worksite will enable the identification of physical hazards such as areas not suitable for ladders and other platforms. Careful analysis of different tasks involved in the job will also help in identification of fall and other hazards involved in working at heights. Another source for knowing possible hazards at the work site is the previous accident investigations registry.

1.8.2 Analysis of hazards

Once identified, all the hazards are analysed for their potential for fall and also if the worker falls, how much harm it could cause. If the analysis indicates that a particular hazard poses a significant fall risk and could cause harm, then the hazard is considered a significant hazard for working at heights.

1.8.3 Controlling the hazards

Once the hazards are identified, the next step is to keep people safe from the hazards. The preferred methods to control the hazards are to either isolate, eliminate or minimize the hazards. The best way to deal with a hazard at the work site is to completely eliminate it. For example, using a low maintenance construction material and/or installing air conditioners at the ground level would significantly reduce the need to work at heights and therefore, reduce/eliminate risk. Where the elimination of risk completely is not possible, the other alternatives are to either minimise or isolate the risk. While working at heights, there are several options for minimising or isolating the risks/hazards and they are as follows:

- Scaffolding
- Edge protection
- Mechanical access plan

- Safety mesh.

Several training providers in Waikato, New Zealand offer 1-2 days course for working at heights. Among these providers, Vertical Horizonz is a big multinational training provider with a large data base. Therefore, a detailed review of working at heights training program offered by Vertical Horizonz is provided below.

1.9 Vertical Horizonz and "working at heights" training course

Vertical Horizonz is a multinational company that has its presence in New Zealand, Australia, and Middle East Asia (Vertical Horizonz New Zealand 2019). Vertical Horizonz New Zealand (VHNZ) is a registered private training establishment and was accredited with NZQA in 1998. It is recognised as a leader in providing training solutions and offers many different training courses in the Health and safety. Vertical Horizonz provides three different courses in working at heights, Basic, Advanced and Refresher course. The courses are conducted in a small class size of 8-10 trainees. Among the three courses, the aim of Basic course is to teach and successfully enable a trainee to check and fit a safety harness, to use a safety harness for fall prevention when working at heights. The aim of Advanced course is to enable a trainee to use, install and disestablish proprietary fall arrest systems when working at heights.

1.9.1 How the study could benefit Vertical Horizonz

Although Vertical Horizons has been training the workers for working at heights for many years, a systematic evaluation of the effectiveness of the training program has not been undertaken so far. Hence, the results from the study will (i) identify the effectiveness of working at heights training program in improving the safety practices (ii) serve as a feedback and help Vertical Horizonz to modify the training program if necessary.

1.10 Aims and Objectives

New Zealand has come a long way in implementing the Health and safety regulations at the place of work. In addition to the agriculture, the construction industry contributes significantly to New Zealand's economy. The construction industry contributes strongly to business, employment, and GDP. The construction industry is the fifth largest employer in New Zealand. Falls from heights are a major problem in construction. The research has revealed that economic cost of falls in New Zealand are estimated to be around $24 million a year and this does not include the human cost as a result of falls. Several safety policies and procedures have been put in place to counter act accidents and protect people working at heights in construction. Despite the considerable amount of measures and research, falls remain a major problem in the construction industry.

In several countries, an administrative control of fall-protection training is recommended to be an effective measure for decreasing fall incidents/accidents. Some studies have shown that well-developed safety-training programs do make a difference in preventing falls. However, to date the effectiveness of working at heights training in improving the workers safety practices has not been thoroughly investigated in New Zealand. Hence, in this study the effectiveness of the 'working at heights' training program in improving worker safety practices was investigated with the following aims and objectives:

Aim 1: Recruit the employees who have not gone through the training (pre-training) and the employees who have gone through the training and have been working for various periods (6 Months, 12 Months and 24 Months) of time (post-training) to measure the effectiveness of the training using questionnaires.

Aim 2: Using data from the pre-training and the post-training responses, determine the effectiveness of the training in improving the safety knowledge, safety behaviour, safety attitude, risk acceptance, work practices and hindrance and facilitator factors for the safety implementation.

Aim 3: Using the post-training data, investigate the effectiveness of the training/refresher training on the ability of the workers to retain knowledge and safety practices over a period of time.

2 Chapter Two: Review of Literature

Complete removal of the hazards at worksites will be the best solution for preventing accidents at the work sites. However, it is well known that it is impossible to remove all the hazards from working sites and therefore controlling them would be the next best alternative. It is noteworthy that the training can be used as an important tool to impart the safety knowledge to the workers so that they can be entrusted to make important decisions about reducing the hazards and maintain the health and safety at the work sites. In this study the effectiveness of the 'working at heights training' provided by the VHNZ is evaluated. Therefore, the review of literature will focus on the health and safety training, its strategies, benefits and how to measure the training effectiveness.

2.1 Health and safety training

Health and safety training is also considered as a way to empower the employees. The empowerment perspective of the training basically gives the employees a priority to remove the hazards to control risks at the work sites. In order to achieve this goal, the training programs should be designed and taught in such a way so as to enable the employees to identify the hazards and effectively remove them by lobbying successfully to the employers, government and unions if necessary. Local legislation gives the employees the right to know (RTK) the risks involved in a job. Therefore, the training programs of health and safety, that are designed according to the local legislation, fulfil the right to know aspect of the legislation and help the employees to take action and reduce the risks that come with the job. Hence, the training provides foundation in educating the employees about risks. Given the importance of the training in health and safety education, the most important question is what medium of instruction should be used for training the employees. Nina Wallerstein showed that the training program should be designed taking into consideration the literary skills of the

employees and should be taught in their own language for the effectiveness (Wallerstein, 1992). The research also shows that training of workers by peers achieves best training. This type of peer to peer training encourages and supports collective learning through problem solving, discussion and sometimes could give the workers knowledge and confidence to negotiate with the employers about implementing the safety at the work site (Slatin, 1995).

2.1.1 Health and safety training strategies

There are various different techniques through which the health and safety training is offered. There are passive information based lecture series that are offered as the health and safety training programs. In addition, computer based programmed instruction, learner centred hands on demonstration oriented programs, are also available for the health and safety training. The lecture based programs are mainly offered to give information on the health and safety. Engaging health and safety training programs include the knowledge pertaining to the health and safety along with feedback interventions on the performance of the health and safety of the workers is provided so that they can correct their mistakes by themselves (Hudock, 1994).

Health and safety training methods that involve extensive engaging methods generally focus on developing the knowledge of the participants in stages (Anderson, 1990) and they also focus on the behaviour modification of the trainees (Bandura, 1986). These teaching methods generally include hands on demonstrations of the health and safety. Therefore, it requires very active participations by the workers. In an independent method of the training, the behavioural simulations, an interaction between the trainer and the trainee along with hands-on training is required. In addition, in behaviour simulation based training, a question based discussion about the knowledge acquired or actions performed during the training are also included. In this form of the training, reflecting on what is learnt throughout the course is most important (Zacher & Frese, 2018). This type of hands on and reflection based health and safety training courses help in not only the knowledge acquisition but also in transfer of the

knowledge acquired during the training to the practical situations. In the long term, this type of training will help the trainees to develop their own strategies for handling unexpected safety situations (Frese & Zapf, 1994). Therefore, active training/learning approaches are considered to be significantly better than passive/lecture based approaches. Hence, as gradually the training moves from passive approaches to more active training methods, it is expected that the accidents and fatalities will reduce at work place over time.

2.1.2 Benefits of the training

In many countries the health and safety in work place is regulated by the legislation set out by the authorities. It is noteworthy that introduction of the legislation/laws/regulations alone is not sufficient in reducing the accidents/fatalities at work place. There need to be additional steps and strategies that will be required to safeguard the worker's safety in the place of work. One such measure taken by most of the enterprises in developed countries is the training and retraining of the staff by the qualified instructors continuously such that appropriate interventions in the health and safety are carried out at the most appropriate time to reduce the accidents. One other major outcome of the health and safety training is the improved safety behaviour of the employees which in turn improves every day habits of the employees at work place. In addition, the safe behaviour of the employees is also correlated with in-depth interventions prior to the accidents and extension of the health and safety knowledge (Christian, Bradley-Geist, Wallace, & Burke, 2009). One other benefit is that the training promotes the safety climate which leads to the integration of an organization into a single cohesive unit. Health and safety training also improves general health of the employees. It has been shown that training not only helps reducing disease rates but also improves biological, psychological and sociological health. Bahn and Barratt (Bahn & Barratt-Pugh, 2014) specifically showed that training that enables the workers to efficiently identify the hazards potentially improves the organization's safety environment. Different investigators in the past have investigated the

benefits of the training in various aspects of the health and safety. For example, Warming et al., (Warming et al., 2008) showed that the training has a positive effect on the knowledge acquisition. It was shown that as a result of improvements in the health out comes due to the training, the knowledge acquisition also improved at a work place due to the training. Secondly, it was clearly shown that due to the training a " prevention behaviour" was found to be prevalent among the workers (Stave, Törner, & Eklöf, 2007) confirming that the training leads to improved safety attitude among the workers. Participating in the health and safety training was also shown to induce the safety minded behaviour among the workers (Levanon, Gefen, Lerman, Givon, & Ratzon, 2012).

2.1.3 Training benefits and strategies for construction workers

Falls from heights leading to the injuries and fatalities remain a big concern especially in the construction industry. Majority of the accidents in the construction industry have been shown to be due to falls from three main hazardous activities and they are (i) working on roofs (ii) using ladders, and (iii) working on scaffolds. To reduce the accident rates in the construction industry, fall-protection training was shown to be a good and an effective measure (X. Huang & Hinze, 2003). Several well designed studies have shown that an effective safety-training program helps prevent falls (Kaskutas et al., 2009; Sokas, Emile, Nickels, Gao, & Gittleman, 2009).

Although the training courses for working at heights are available to most of the workers, the accidents still occur. This could be due to many reasons. Lipscomb et al. (Lipscomb, Glazner, Bondy, Lezotte, & Guarini, 2004) showed that many of the falls in the construction industry occur due to the workers not following the standard protocols or were not able to get access to personal protection equipment at the work site. Huang and Hinze (X. Huang & Hinze, 2003) analysed a 10-year worth of data from the construction accidents and concluded that, the worker misjudgement of fall hazards, more often than not, leads to falls in

the construction industry. Furthermore, Hinze's research (X. Huang & Hinze, 2003) also showed that, the worker's personal experiences with the fall risks and hazards does not diminish the accident rates. These studies indicate that there needs to be a constant refresher training with updated knowledge for the workers to prevent falls in the construction industry. In addition, Wojcik et al.(Wojcik, Kidd, Parshall, & Struttmann, 2003) showed that the training content should be relevant and linked to the specific job of the construction trade to be an effective tool in reducing the accidents. This stems from the fact that the workers on the roofs perform different types of tasks that are not related. For example, the construction workers who work with iron on the roof spend a considerable amount of time using one or both arms above the shoulder level and at the same time their feet rested on uneven or some time unstable work surfaces (Forde & Buchholz, 2004). The ergonomic risks of the iron workers are significantly different from other roofing workers who have other risk factors. Another example is the framing workers. They perform work related to the wall frames and their hazards such as loss of control of the wall panel, cuts during mounting, failed truss setup are not similar to the roofing workers (Mitropoulos & Guillama, 2010). These examples support the case for a profession specific training for the workers at heights. Research by Kaskutas (Kaskutas et al., 2009) indicated that the training does indeed prevent roofing accidents and also reduce the health risks such as back disorders. However, the problem has been shown to be non-availability of the job specific training (Mitropoulos & Guillama, 2010). Therefore, the current training protocols for the fall-prevention need revision and improvements to be more job specific, so that it can become very effective and relevant in the industry.

2.2 Measuring training effectiveness

In companies that are trying to improve the safety, worker training is considered to be the most important intervention. As a matter of fact some of the early published work showed that the companies that adopted the worker safety training have been successful in their business

(Cohen A, 1977). Although correlative studies confirm that worker training in the safety is important for a company's success, the effectiveness of the training with respect to longer term outcomes of the health and safety are not thoroughly investigated especially in working at heights in New Zealand. Annually more than $40 million is spent on the safety training in USA alone (Lee, 1988). Given the importance, many attempts have been made to assess the effectiveness of the training programs. Since there is a lack of consensus in the methodology, the efforts to measure the effectiveness continue to frustrate the academics in New Zealand and world-wide. In this section of the review of literature, the previous studies that were conducted to evaluate the effectiveness of the training is reviewed.

2.2.1 The difficulties faced in evaluating training programs

Currently, extensive training programs have been designed for diverse worker force all across the world. Due to worker migration all across the world, many of the participants in the training in different countries are very diverse with different backgrounds, cultures, language abilities and literacy backgrounds. This type of diversity in the work force has really complicated the way success of the program has been defined. Successfully measuring the changes in the safety at work alone is not sufficient any more when it comes to evaluating the training programs (Cohen Art, 1977). Most of the evaluating studies appear to focus on the processes followed in the training programs, and short term effects of the training programs. The outcomes that are generally measured are (1) participant satisfaction with the training (2) knowledge acquired as measured through tests at the beginning and the end of the program (3) worker self-reported enhanced positive attitudes towards safety and (4) improvement in the worker's safety skills as measured by the instructor (Thomas G. Robins & Klitzman, 1988). As opposed to the pre-training measurements, the post-training outcomes are seldom done to measure the training effectiveness. Direct measurement of the safety outcomes has been difficult (McQuiston et al., 1994). To monitor how the training improves the safety outcomes, several investigators

have scanned the health records of the workers to measure reduced occupation illness and injuries. However, these studies proved that the personal records are unreliable (T. G. Robins, Hugentobler, Kaminski, & Klitzman, 1990). Another substitute measure for assessing the training efficacy in the literature has been the changes implemented by a company that led to the safer working conditions and the safety climate (Deutsch, 1996). Overall, measuring the effectiveness of the training is not straightforward.

2.3 Safety outcomes used in measuring training effectiveness

2.3.1 Safety knowledge

The health and safety of the employees include both mental and physical aspects of well-being (Pink et al., 2016). To implement successfully the health and safety regulations, it is paramount that management first identify the work place hazards and standardize protocols to mitigate or remove the hazards in proactive ways. Critical to an effective implementation of the health and safety in an organization is the extent to which a company has an integral health and safety knowledge (IOSH, 2006). Ahmad and Gibb (Ahmad, 2003) further suggest that this concept of the health and safety knowledge is basically a function of the employee outlook towards learning new knowledge and practising them at the place of work. Ahram, et al.(Ahram, 2012) found that attaining the safety knowledge by the workers has been structured around four main categories: capturing knowledge, transferring knowledge, knowledge creation, and knowledge integration. In the first instance, the emphasis is to capture the safety knowledge from many sources including the training. Subsequently, the focus shifts to transferring the knowledge and creation of fruitful safety practices which in turn can lead to creation of further knowledge and transfer. Knowledge integration is the final stage or it can also be seen as an end product of the safety knowledge.

These days tremendous pressure is put on workers to increase efficiency, productivity and quality at workplaces to survive global competition. Furthermore, in the new millennium,

there are rapid changes in the ownership, management, and technology, in the manufacturing sector. All these changes have immensely affected the health of the workers in a negative way. However, occupational health and safety practitioners, and agencies that deal with the health and safety such as the European Agency for Safety and Health at Work have clearly identified that if an organization is open to quickly capturing new knowledge in the safety and transfer the knowledge to its employees, it is possible to reduce stress and be productive. A clear example of the safety knowledge acquisition failure and not using the research knowledge on the health and safety is inability to reduce the musculoskeletal injuries in the manufacturing sector by the companies. Panel on Musculoskeletal Disorders (2001), has clearly identified many favourable ergonomic and bio-mechanic measures that could alleviate the musculoskeletal disorders. However, these interventions are not implemented in many companies as uptake and utilization of the latest research information is poor in many companies. Particularly, the knowledge transfer process and the knowledge utilization have received limited attention.

2.3.1.1 Safety knowledge transfer

The research on how companies capture the safety knowledge and subsequently transfer and utilize it started nearly 50 years ago (Valente & Rogers, 1995). However, not all the new health and safety knowledge that is generated due to the research is taken up by the industry. Hence, a significant research was conducted to see what attracts a company to capture new knowledge in the health and safety. The analysis indicates that the new health and safety concepts that are suitable and directly applicable to the worker's needs, considered highly relevant, presented in an appealing manner and easy to understand and implement (Kramer, Cole, & Leithwood, 2004) are captured by the industry for implementation. It was also discovered that, the knowledge presented as a "key idea" rather than the results and data points (Lavis, Robertson, Woodside, McLeod, & Abelson, 2003) is more often absorbed as new knowledge by the

companies. A few other studies have pointed out that source of the knowledge is very important however some studies have disputed it (Cousins & Leithwood, 1993). Fullan (Fullan, 2016) found that the relativeness and context of the knowledge for the organization is important for the effective knowledge uptake, transfer and utilization. Furthermore, it was discovered that there is no consistency or consensus in decision making about what kind of safety knowledge is of value for the organization (Walshe & Rundall, 2001). However, approval of the senior management and their commitment was found to be vital for acquisition of external source of knowledge (Dov Zohar, 2002). Similarly, the interest of the company in the external knowledge is also very important (Van de Ven, 1999). Molitor et.al., (Molitor, Parker, & Vetter, 2018) showed that the organization's continuous use of the research is also critical for the knowledge acquisition.

2.3.1.2 Safety knowledge transfer in construction industry

Health and safety is critical in the construction industry. However, statistics show that it is hazardous to work in the construction industry since the construction industry has a poor performing record (Loosemore & Lam, 2004). During 2003-2004, in England, 3,760 major injuries were reported in the construction industry and most of these were falls from heights. Furthermore, in 2004-2005, there were 69 fatalities reported in the construction industry. Hence, the extent of injuries and fatalities make the construction industry a risky business for the employees. Investigation by the authorities identified that lack of the health and safety knowledge due to inadequate education and training contributed to approximately 70% of the accidents studied. Furthermore, Teo et.al., (Ai Lin Teo, Yean Yng Ling, & Sern Yau Ong, 2005) found out that "don't know" is single most reason for unsafe worker behaviour at the construction sites. Similarly, Edward and Holt (Edwards & Holt, 2008) showed that a significant number of the fatalities on a construction site has been among the workers who have worked there for less than two weeks and therefore have not had a chance to completely

acquire the knowledge of the health and safety. Therefore, investigative evidence suggests that the health and safety knowledge acquisition, transfer and utilization is extremely important for working safely at the construction sites.

2.3.1.3 Safety knowledge management

Buckley and Carter (Buckley & Carter, 2003) described a knowledge management method that was implemented in the mining industry to help the workers follow the health and safety rules and regulations and reduce the accidents. The knowledge management protocol included 6 specific steps; (a) mapping knowledge in the organisation, (b) carrying out a knowledge management audit, (c) identifying knowledge gaps and needs, (d) appointing project teams and initialising projects for acquiring and documenting knowledge and, after their completion, (e) overviewing and assessing the results in view of reimplementation of the knowledge management processes in accordance with the principles of continuous improvement. This process of the knowledge management of Occupation Safety and Health resulted in reduced accidents and proven to be efficient. Floyde et.al., (Floyde, Lawson, Shalloe, Eastgate, & D'cruz, 2013) used tacit knowledge in the health and safety management. In addition, many social researchers successfully used story telling as a means to manage knowledge of the health and safety in miners. Regardless of the method used, the knowledge management did indeed provide encouraging results in not only inculcating good health and safety practices but also in reducing the accident rates.

2.3.1.4 Safety knowledge as a measure of training effectiveness

In the Kirkpatrick's model of learning how much content of the training course has been learned by the employees is routinely used as a measuring tool. In order to measure the knowledge gained typically a pre and post-training test is administered. This sometimes causes anxiety among the workers/participants and hence large organizations refuse such testing. Recently,

several studies used the safety knowledge as a measure for evaluating the training effectiveness (Clarke, 2006; Mustard, 2019). This involved testing the pre and post-training participants with key technical and other content based questions to ascertaining whether the participants learned anything new during the training.

2.3.2 Safety Behaviour

Research has clearly documented that about 80% of the work related accidents are caused by the employees' safety behaviour (Pidgeon, 1991). The safety behaviour of the employees can be improved by firstly identifying bad working habits of the employees that could lead to the accidents and promptly replacing them with good working habits. While the safety behaviour is critical and is considered a work related skill, the unsafe behaviour of the employees can act as an early warning system for the accidents and incidents. The employees sometimes engage in at risk behaviour thinking that it will lead to their improved performance. Some of the common at risk behaviour seen are (i) not wearing proper personal protective equipment (PPE) in order to save a few seconds. (ii) ergonomic factors – some of the inappropriately designed machine controls that could potentially lead to the adoption of the improvised and potentially dangerous methods (iii) accepted practice –some of the unsafe practices are often adopted with a notion that "we've always done it that way" (iv) unsafe practices often are practiced with a notion that – "my supervisor turns a blind eye when we do this because it is faster". Therefore if these safe/unsafe behaviours of the employees are measured before and after the training, it will provide information on the effectiveness of the training (Cooper, 2009).

For measuring the safety behaviour it is important to identify critical safety behaviour that is pertinent to a place of work. Sometimes these can be prepared from the accidents and near misses report. In determining the safety behaviour, the near misses are more important than the accidents as they would give an indication of the behaviour that could lead to possible

accidents (Tuncel, Lotlikar, Salem, & Daraiseh, 2006). One way to improve the safety behaviour at work is to have the management show their commitment to the safety. This is accomplished by conducting periodic safety audits, encouraging employees to report the safety lapses or unsafe practices (Locke & Latham, 2002). Therefore, to measure the effectiveness of the training, questions regarding the commitment of the management towards the safety behaviour can be included (Locke & Latham, 2002). In addition to the good safety behaviour, it's also essential to understand why some employees might behave unsafely. Several reasons have been known for the bad behaviour. One of the most frequent reason for the bad safety behaviour is short deadlines and increased work pressures. Another reason is the uncomfortable nature of the safety equipment and therefore not wearing PPE (Mulenga, Bagraim, & Smallwood, 2011).

To improve the safety records, good safety behavioural approaches were first developed and enforced in the USA. Komaki et al first documented the application of the behavioural approaches to enhance the occupational safety (Komaki, Barwick, & Scott, 1978). Their results showed that first defining the safe work practices through work place behaviour and then reinforcing them tremendously improves the health and safety at work (Komaki et al., 1978). In addition Krause and Hidley (Krause & Hidley, 1989) showed that the quality management, training and employee participation together are the key elements that can improve the safety behaviour at work. Furthermore, Krause et al (Hicks, 1998) showed that peer to peer communication among the workers would significantly improve the safety behaviour. Sulzer-Azaroff later on showed that it is equally important to understand the reasons and factors that initiate the bad safety behaviour in a company in order to change and improve the behaviour (Sulzer-Azaroff, 1987).

2.3.3 Knowledge Skills and Attitudes

Safety training has been described as "the systematic acquisition and development of the knowledge, skills, and attitudes required by employees to adequately perform a task or job or to improve performance in the job environment". In other words, the training can be interpreted as the activities that will help in gaining new knowledge, new skill sets and attitudes about the safety and the three activities are abbreviated as KSAs. Furthermore, training also helps the trainees to acquire the ability to apply KSAs at the work site. It is noteworthy that one of the key goals of the training is to improve performance at work by working safely (Burke, Sarpy, Smith-Crowe, & Chan-Serafin, 2006). Another goal of the training is to impart the ability and prepare the employees to meet new challenges and deal with the changes at work (Burke et al., 2006). Given the aims of the training, the effectiveness of the training on the workers can be measured by assessing if there are improvements in the safety knowledge, safety skills, problem solving skills and safety awareness in an individual after the training when compared to before the training. Several studies have indeed shown that the safety training resulted in improving the employee safety compliance more than those employees who have not undergone the safety training (Burke et al., 2006). Another measurable feature to measure the effectiveness of the training is the change in the employee behaviour which will result in improved understanding of the safety procedures and why they should be followed at work site (McIlwraith, 2006). Since the employees develop respect and appreciation for the safety regulations due to the safety training, risk control by the employees can also be used as a measure to assess the training effectiveness (Crutchfield, 2014). One other factor that can be used to measure training effectiveness is the safety performance by the employees. It is important to note that safety performance is not due to a single factor but it depends on a number of factors. The extent to which the safety knowledge, safety skills and attitudes have been understood by the employee during the training is adjudged by measuring the ability of

the employees to 'transfer of training' to the job and for how long the employee maintains that KSA.

Training effectiveness can also be evaluated, by the extent to which an employee, who has undergone training, can remember and demonstrate the learning outcomes of the training. Kraiger et al. (Kraiger, Ford, & Salas, 1993) established that there are three important learning outcomes as a result of the safety training and they are (i) cognitive outcomes, (ii) skill-based outcomes, and (iii) affective outcomes. The cognitive outcomes of an employee are the ability to remember and recall new safety knowledge taught during the training. Similarly the skill-based outcomes are described as the reduction in error rates and increased speed with which tasks are accomplished seen as a result of the training. The affective outcomes are shown to be related to motivation to follow the safety rules, have a good attitude towards the safety at work. Experimental studies have shown that the safety training positively influences the safety outcomes and increases supervisor adjudged safety rating and performance of an employee (Burke et al., 2006). These studies also found that the training resulted in an increased use of PPE, reduced risk-taking work habits, and constantly engaging in the health and safety information communications with peers and supervisors. Vinod Kumar & Bhasi (Vinodkumar & Bhasi, 2010) showed that the safety training is the most important safety management tool to reduce the accidents in India. In their research they found that the safety training would lead to an increased safety participation and compliance along with the safety motivation and safety knowledge. Leiter et al. (Leiter, Zanaletti, & Argentero, 2009) found that the workers who undergo the safety training are more confident in the work force to talk about the hazards they came across. Finally, the research also showed that two additional factors can be used as an evaluation tool to monitor the safety courses. Proper training with satisfaction would result in the employee commitment towards the safety and therefore it is possible to measure the safety

behaviour and accident reduction as parameters for the training effectiveness (Stackhouse & Turner, 2019).

2.3.4 Safety climate

Safety climate is defined as "the perceived value placed on safety in an organisation at a particular point in time." These perceptions and beliefs can be influenced by the attitudes, values, opinions and actions of other workers in an organisation, and can change with time and circumstances (Kines et al. (2011).

Research on the safety climate was initiated by Zohar (Dov Zohar, 1980) almost forty years ago. Zohar initially evaluated the employee perception of the safety by doing a survey in more than 20 companies in Israel. Zohar's research identified that there are eight critical elements that influence the safety climate- in a company and they are (i) safety training (ii) management attitude (iii) safe conduct (iv) risk taking by the employees (v) the effects of how fast the work needs to be done on the safety (vi) the importance placed on the work done by the safety officer (vii) the influence of the safe conduct on social status of the employee and (viii) the importance the organization places on the safety committee. In summary, the research suggests that the managers and employees should assume multiple levels of the safety and provide a more balanced approach for improving the health and safety practices of the employees at work (Hofmann et al., 2017).

Griffin and Curcuruto (Griffin & Curcuruto, 2016) showed that the enhanced safety climate could be potentially due to a good communication of the safety policy, being coherent and effectively communicated across the organization. At the same time, a strict enforcement of these policies by the organization also contributes towards the good safety climate. This efficient enforcement in turn gains the confidence of the employees and at the same time allows the employees to witness the management's commitment to the safety and not prioritise production over safety. In contrast, poor safety climate in an organization has been shown to

be as a result of inept and inconsistent actions by the management (D. Zohar, 2014). Poor safety climate leads to reckless behaviour at the employee level leading to increased injuries, increased expenses and reduced productivity at the organization levels (Probst & Estrada, 2010). Hence, a poor safety climate record would lead to a reduced perception of the safety activities in the workplace, which in turn leads to reduced safety related outcomes (Tholén, Pousette, & Törner, 2013).

2.3.4.1 Factors influencing safety climate

Mohammad subsequently proposed an extensive model for the study of the safety climate in an industry (Mohamed, 2002). This model works on a hypothesis that the safe work practices by all the employees in an industry are as a result of existing safety climate. The safety climate in turn is dependent on five independent factors which include:

- Safety commitment by Management
- Confidence and awareness
- Risk Acceptance
- Work practices
- Accident Reduction

2.3.4.2 Safety commitment by management

Management of any company plays a critical role in promoting and enforcing the health and safety. It is also important to realize that the management commitment to the safety is essential for the safety climate (Dov Zohar, 1980). In terms of maintaining the safety climate, the role of the management is above and beyond establishing the safety policies. Many studies demonstrate that the management's commitment towards enforcement is an important factor in determining the satisfactory levels of the safety in a company (Jaselskis, Anderson, & Russell, 1996; Langford, Rowlinson, & Sawacha, 2000). Furthermore, these studies also identified that, when the employees are convinced that the management believes in their

personal safety, then the employees will be more willing participants in the safety. Therefore, it could be hypothesized that when the management shows firm commitment towards the safety, a positive safety climate prevails in a company.

Generally, in a company, it is expected that the management establish a robust health and safety policy and use both formal and informal communication means to inform its employees about the management's commitment to the safety (Baxendale & Jones, 2000). In addition French and Steel (French & Steel, 2017) indicated that the feedback provided by the employees about the health and safety and further commitment by the management to implement the changes suggested by the employees is equally important to maintain the safety climate in a company. In summary, communication by the management is extremely important for the safety climate in a company.

2.3.4.3 Confidence and awareness

Safety awareness occupies a special significance when it comes to the industrial accidents. Safety awareness has been shown to significantly influence the safety climate and performance. In the construction industry, one way to improve the safety awareness is through improved acquisition of the safety knowledge through the safety training (Monahan, 2010). An effective safety training results in having a good safety awareness in the employees which in turn encourages the improved safety performance. The research has shown that both the safety training and safety awareness are two major determinants of the safety performance (Kundu, Yadav, & Yadav, 2015). Safety awareness is thus considered one of the evaluating factors in the current study. An in-depth study investigated how the safety behaviours affected the safety at a construction site (Quinn, 2010). The results reveal that the level of the safety awareness of a construction worker is influenced by (1) work site environment and (2) social influence. While the work site environment influence is self-explanatory, the social influence can be explained by peer pressure, persuasion by co-workers and profits (Apostolou & Zacharia,

2015). In addition, the results also revealed that the workers who have a very good relationship with each other share a similar safety climate. Another observation from this study was that if the workers believed that their behaviour has an impact on their peers, it is more than likely that they will 'behave properly'(Langford et al., 2000). However, if the employees did not care for the impact of their behaviour, then that will lead to a lack of sense of responsibility and may not be willing to comply with the safety measures. The most influential safety factor was found to be the safety awareness followed closely by the communication (Ismail, Doostdar, & Harun, 2012). Therefore, improving the safety awareness and confidence is the key to improve the safety practices.

2.3.4.4 Work practices

Rules and procedures are the critical components of the health and safety management system in a company. Cox and Cheyne (2000) showed that the safety levels in a company were directly proportionate to the positive perception of the safety regulations by the workers (Cox & Cheyne, 2000). Peng et.al (Peng, Hong, & Ru-Yin, 2011) showed that the lapses and problems in the safety can be invariably linked to either lack of the procedures or inconsistent enforcement of the safety rules and procedures. Therefore, it can be concluded that good safety climate exists in a company when there is a positive perception of the safety rules and regulations by the employees of the company. Goldberg et al. (Goldberg, Dar-El, & Rubin, 1991) showed that the existence of a good supportive environment among the workers leads to a closer working relationship and the safety concern for all the workers involved in a project. Thus, another hypothesis that can be drawn is that having a high level of supportive environment in a company leads to more positive attitude and safer climate at work. Circumstantial evidence indicates that, the involvement of the workers is important for proper safety activity in the company (Niskanen, 1994). Furthermore, the research indicates that getting the workers involved in developing the safety interventions and policies is equally

important for a good safety environment in the company (Williamson, Feyer, Cairns, & Biancotti, 1997). The research (Williamson et al., 1997) also shows that it is important that the workers need to get involved in the procedures that involve reporting the injuries and solutions for the hazardous situations. Therefore, the literature supports the hypothesis that the higher the involvement of the workers the better the safety climate in a company.

2.3.4.5 Risks and accidents

There has been a circumstantial evidence that an effective training of the safety will lead to reduced injuries and accidents. Therefore, one of the ways to measure the effectiveness of the training is to investigate if the training has led to reduced injuries in an organization (Börger et al., 2011). Consistent with this theory, Reason's model, suggests that an improper training leads to an increase in the accident rates and/or major accidents (Elliott, Page, & Worrall-Carter, 2012). The mechanism behind this is thought to be more psychological in nature as an effective training will lead to an improved attitude, perceptions and behaviour of the employees leading to an improved safety culture and reduced accident rates. Therefore, it can be said that the safety training would result in an indirect effect on the organisation. One noteworthy fact supported by the literature is that psychological variables at an individual level have an effect on the training effectiveness at organisational levels (Amde, Marchal, Sanders, & Lehmann, 2019). This hypothesis is further supported by Holton (Holton, 2005) who showed that the variations in an individual's ability to learn and perform affects the effectiveness of the training which in turn influences the organisational performance.

2.3.4.6 Safety climate in construction industry

The construction industry is thriving in New Zealand and world-wide and therefore it represents a significant part of any country's economy. Majority of the work done at a construction site involves working at heights where significant number of deaths and injuries

are reported. Hence, it is rated as a dangerous industry. Therefore, reducing the accident rates and improving the safety climate in the construction industry has become a top priority world-wide. Over the years, there is a considerable research done in this area. The published literature indicates that different motivating factors lead to a better safety climate in the construction industry across the world. For example, it was discovered that by strictly establishing the safety rules and regulations along with the training resulted in a good safety climate in the construction industry in China (Zhou, Fang, & Mohamed, 2011). In a study done in New Zealand, it was revealed that a positive commitment towards the safety by the management along with good social support and reduced work pressure led to good safety climate (Guo, Yiu, & González, 2016). Furthermore, the study also pointed out that the production pressure was the single most important factor in adversely affecting the safety climate at the construction site (Guo et al., 2016). In another study from Ontario, Canada, it was shown that establishing a safety climate is key for adhering to the safety rules by the employees (Chen, McCabe, & Hyatt, 2017). In addition, the study also found that good safety climate reduced psychological stress (Chen et al., 2017). A South African study further illustrated that, adequate safety procedures, safety training, and positive and constructive communication are essential for the safety climate at the construction work place (Boshoff & Krugell, 2017). Interestingly, a Hong Kong study found that having a good safety climate could be used as an investigative tool for not only evaluating but also enhancing the site safety at the construction sites (Choudhry, Fang, & Lingard, 2009). Furthermore, the study discovered that evaluating the safety climate would indicate to the management of possible safety failures (Choudhry et al., 2009). Another study conducted in Hong Kong identified the management commitment, safety procedures, and risks are important contributors for maintaining the safety climate. In addition, the study also demonstrated that the perceptions of the workers about the safety climate depended on the citizenship, marital status and alcohol consumption (He et al., 2016). A Colombian study found

that safety climate scores varied depending on the hierarchical position in the company. The managers scored the highest, followed by the supervisors and the labourers (Marín, Lipscomb, Cifuentes, & Punnett, 2019). Therefore, it can be concluded that wide ranging factors influence the safety climate across the world at the construction sites.

2.3.5 Facilitator factors and hindrance factors

The research over the years has shown that there is a gradual increase in the number of the organisations that are adapting and complying to Occupational Health and Safety systems according to the legislation of their respective countries. Many of the companies follow this trend since implementing the health and safety system leads to positive effects on morale of the employees and the productivity (Fernández-Muñiz, Montes-Peón, & Vázquez-Ordás, 2009; Frick, 2011).

Previous research has shown that a strong commitment by the top management of an organisation is essential for the successful implementation of the health and safety regulations (Gallaghar, 2000; Noblet & LaMontagne, 2006). In addition, several other factors such as the management support and commitment (Wu, Chen, & Li, 2008), the employee involvement and participation (Noblet & LaMontagne, 2006), an appropriate training (Fernández-Muñiz et al., 2009) are also found to be the key for the implementation of the health and safety regulations in a company. Factors such as financial resources, the number of supervisors implementing the health and safety, and the external safety environment were also proven to be the important factors for the health and safety in a company (Lynda S. Robson et al., 2007). Kjellen, (Kjellén, 2012) discovered that additional factors such as the regulations in a country and the authority handling these regulations and economic wealth of the country are also important when it comes to implementing the health and safety. Some of the important factors and how they contribute to a successful implementation of the health and safety are discussed below.

2.3.5.1 Resource factors

In any company for a successful implementation of the health and safety, a required amount of resources need to be provided. The essential resources include not only hardware but also the software and other financial resources. It is essential that the company first identifies the risks and hazards and provides not only personal protective equipment (PPE) but also any special safety equipment required to overcome the identified hazards. In addition to the safety equipment, the First Aid equipment and the training how to use it are also a part of required health and safety protocols. The resources required for an emergency response planning and recovery must also be allocated. Sørensen et al. (Sørensen, Hasle, & Bach, 2007) showed that the small enterprises in general do not allocate the required resources and hence are proven to be more hazardous as compared to the large enterprises. Hence, Sørensen et al. (Sørensen et al., 2007) hypothesized that the resource allocations are dependent on the size and financial strength of a company.

2.3.5.2 Management factors

Another important element for the successful implementation of the health and safety in a company is the management support. There are several factors included under the management factors and include leadership vision for the safety and commitment, providing direction, adequate support for the supervision, analysis of the safety measures, and prevention planning. A study by Mearns and Reader (Swuste, 2008) investigated the relationship between the management support and the safety behaviour in a company. The results showed that an increased organisational and supervisory support that reflected care and concern for the health and safety of the employees resulted in high levels of the safety behaviour of the employees. These results show that the commitment by the management towards the health and safety goes a long way in influencing the safety culture, environment and behaviour in a company.

2.3.5.3 Personal factors

Personal factors of the employees play a critical role in the implementation of the safety rules in a company. Personal factors of the employees include good communication skills, safety attitude, safety culture, positive attitude, and personal competency. The employees with good personal factors will enhance the safety culture and behaviour which in turn promotes the safety environment in a company.

2.3.5.4 Human resource management and incentive factors

Some of the factors that are generally included in a company under the "Human Resource Management (HRM) and incentive factors" are the remuneration to the employees, merit ratings and promotions, working conditions and personal protection equipment (Flin, Mearns, O'Connor, & Bryden, 2000). The HRM also includes the safety practices of the employees, and training/retraining offered to the expert staff. It has been previously shown that the general welfare of the workers (Van Hemel, 1997) and conducive working conditions at a company contribute to the increased safety practices (S.V.S.Raja & K.P.Reghunath, 2010). Similarly, the training programs and use of the latest technology to reduce physically demanding work (Scott & Renz, 2006) led to an increased safety at work. Therefore, HRM initiatives play a critical role in reducing the accidents and increasing safety at the work place.

2.4 Safety training evaluation methods

2.4.1 Kirkpatrick evaluation method

The Kirkpatrick evaluation model is a widely used method to assess the effectiveness of a training. Kirkpatrick method contains four assessment levels to evaluate the effectiveness of a training programme (Reio, Rocco, Smith, & Chang, 2017):

Level 1 – *Reaction*

In this level the appraisal measures how the participant in the training reacted to the training received. In addition the evaluation also measures how satisfied the participant was with the training program.

Level 2 – *Knowledge/learning*

Learning during the training leads to acquisition of new knowledge. Therefore, the new knowledge will lead to a change in the safety attitude, improved skill sets and over all knowledge about the health and safety. Therefore, in this level, the comprehension of new acquired knowledge can be assessed to measure the effectiveness of the training program.

Level 3 – *Behaviour*

The assumption in this level is that once the new knowledge about the safety is acquired and assimilated, it will invariably lead to a change in the safety behaviour. The extent to which the 'transfer of training' has occurred, therefore, could be measured so as to assess the effectiveness of the training program.

Level 4 – *Results*

Successful training program participation results in an overall improvement in the performance of the workers. Hence, the 'results' of the performance such as an increased production, sales, quality and profits, decreased costs, reduced frequency of the accidents and injuries, a reduction in staff turnover can be used as proxies to measure the effectiveness of a training program.

Frequently the companies use only "reaction" (level 1) to measure the effectiveness. Some studies have also used the learning ability (32%), behaviour changes (9%) or level 4 results (7%) as the measurement tools for evaluating the effectiveness of the training programs.

The effectiveness of a training program can be measured over time. To assess the initial immediate reaction to a training program, the survey may be conducted shortly after the training program finishes. It is noteworthy that to measure the effectiveness of the training

programs using evaluation of levels 2–4, the assessment must be carried out over a longer period of time.

It is very well known that the companies do depend on the training programs to improve their safety. However, what is surprising is that there is little effort on the part of many companies to measure the effectiveness of the training program over a period in terms of improving results. A comprehensive review of the training evaluation by 80 different companies revealed that more than half the companies assessed the training effectiveness in less than 3 months after the training (Biron, Burke, & Cooper, 2014). The problem with such evaluations is that they will only measure the short term effectiveness of the training programs. Furthermore, majority of these studies have only focused on a very narrow range of the safety outcomes with no consideration for the broad outcomes of the safety training . Hence, there is a clear vacuum in the literature when it comes to longitudinal data on the training effectiveness in the industry. There is no question that the prevailing workplace safety climate in a company is a clear indication for the broader impact of the safety training and also long term effects of the training program. Therefore, in the literature it is suggested that measuring the training impact on the safety climate over a long period of time will be a true measure of the training impact on the safety. This is especially true for working at heights since the projects are long and the safety infringements may occur due to over confidence seen in the experienced employees.

2.4.2 Fraccaroli and Vergani methods

Fraccaroli et.al.,(Vignoli, Punnett, & Depolo, 2014), reviewed the literature on the training evaluation and formulated another model to evaluate the safety training effectiveness. These authors observed a broad agreement among different approaches taken by different authors. Some of the consensus Fraccaroli and Vergani observed was in the measurement reliability. In addition, Fraccaroli and Vergani found that the other literature points out to the complexity of

the training evaluation process. Based on the extensive research, Fraccaroli and Vergani propose several different models that are described here. The First approach is called "Classical" model. In this method the emphasis is on the achievements of the training program. In another model of "Scientific" evaluation of the training effectiveness is done as an experimental approach using the quantitative measures so that the effectiveness can be quantified. In a third model of "Comparative" method of measuring the effectiveness of a training, a ratio between the costs and the benefits are measured for different programs. Some authors have used a qualitative assessment method termed "Overall judgment" to measure the effectiveness of the safety training. In the "Decision making" method, the evaluation of safety training effectiveness is done qualitatively to produce information for the manager who makes decision on the training effectiveness. In the "systemic" way of measuring effectiveness, the relationship between input and output of a training program is analysed. "User-centred" programs analyse how much useful information is given to an individual during the training program. "Goal-free" method of measuring effectiveness tries to evaluate how much unexpected information is passed on during the training that is not pre-planned. Finally "Responsive" method measures the relationship between the members of the system being evaluated. The User-centred, Goal-free and "Responsive" are the three latest models which are considered emerging (Scaratti, Kaneklin, Silvio, & Gorli, 2009). Currently there is a lot of scientific debate regarding the evaluation procedure. While the discussion continues in the field, most of the researchers are using quantitative methods described by Kirkpatrick four-level model (1965).

2.4.3 Realistic Evaluation Method

Pedersen and colleagues (Pedersen, Nielsen, & Kines, 2012) hypothesized a new model known as " Realistic Evaluation (RE) " to evaluate occupational safety training programs. Initially, Pawson and Tilley (Pawson, Greenhalgh, Harvey, & Walshe, 2005) came up with the first

realistic evaluation approach. Pawson and Tilley hypothesized that for an assessment to be useful to the decision makers, the evaluations must first ask 'what works in which circumstances and for whom?', instead of just 'does it work?'. Therefore, the RE to evaluate the training effectiveness, the evaluators should first identify the mechanisms that elaborate on 'how' the safety outcomes were 'caused' and "what" is the context for which the safety measures are designed. The RE method takes into account, Cochrane criteria or randomized controlled trials (RCT) and also has a lot of advantage such as high internal and external validity (Victora, Habicht, & Bryce, 2004). In the RE model, the context and content of the research regarding the workers, organisation and workplaces are taken into consideration. In addition, in RE model, the emphasis is given to the qualitative measures. A great strength of RE model is that it gives policy makers a comprehensive overview of the variables of the training program and how useful are they in imparting the knowledge to the individuals. One thing to note is that RE model does not evaluate the training program effectiveness on statistical significance which is less useful for the decision making by the senior management. According to Pedersen et al. (Pedersen et al., 2012) to understand the causal relationship between the training methods and the outcomes, it is essential to understand the mechanisms that link them. In addition, it is also necessary to understand the context in which the links and relationships occur. Therefore, the method simply does consider the training methods as useful, but pays equal attention to the context and linking mechanisms that link the training methods and the outcomes.

2.4.4 Influence of training methods on the training evaluation

Two important publications have recently investigated the role of the engagement (that is hands on training) in the training effectiveness. Burke et al., (Burke et al., 2006) investigated the influence of the engagement on the training effectiveness. For the least engaging method, the authors used lecture, videos and pamphlets with absolutely no hands on training. For moderate

level of the engagement the authors used feedback interventions, performance based information communicated in small groups and computer-based interactive instructions. For the most engaging method, an active participation of the trainees in hands on training was used along with the safety simulation during the training. The authors evaluated the effectiveness of these three different training methods on three different safety out comes; (i) safety knowledge (as determined by self-evaluation or by testing of safety knowledge taught in the course); (ii) safety performance (as evaluated by either self or the supervisor or by a neutral observer on the safety behaviour of the trainee) and (iii) safety and health outcomes (as measured by the number of the accidents and injuries or illness). The results demonstrated that the knowledge acquisition is significantly higher if the course is taught in a more engaging fashion. In addition, the results indicated that as the engagement level increased, the negative outcomes of the safety and health reduced. However, the study results concerning the safety performance were less clear, but did indeed support the trend that if the course was taught in an engaging manner, it was more effective in improving the safety performance. In summary, Burke et.al (Burke et al., 2006) showed that an engaging method of teaching the health and safety is three time more effective in imparting the knowledge and skills. In another study by Robson and colleagues (L. S. Robson et al., 2012), a conceptual model was used. This model hypothesized that the training will have an immediate effect on the safety knowledge, safety attitude and behaviour of the trainee. Cumulatively, these three safety outcomes influence the safety behaviour. As a result of this improvement in the behaviour, the long term safety outcomes in a trainee will also improve. While Robson's study (L. S. Robson et al., 2012), have retained similar levels of the engagement as Burke and colleagues (Burke et al., 2006), the safety outcomes also included perceived risks, self-efficacy and behavioural intentions. The results of Robson study showed that the effect of the training on the knowledge, attitude, and beliefs was ambiguous as a sufficient number of studies were not available. However, the

effectiveness of the training on the behaviours was very strong. Therefore, both studies confirmed that a training provided in an engaging manner is highly effective.

3 Chapter Three: Methods

The effectiveness of training in improving safety practices in New Zealand "working at heights" has not been thoroughly investigated before. Therefore, this study was undertaken to assess the effectiveness of training in collaboration with a well-established, multinational training service provider, Vertical Horizonz, New Zealand.

3.1 Data Collection

In this study, both retrospective and prospective cohort studies were employed to investigate the effectiveness of the training program in improving the safety of workers. Quantitative measures were used to address the overall aims of the project. The cohort study designed allowed for the measurement of improvement in safety knowledge, safety climate, safety culture, safety behaviour, minor injuries, facilitating and hindrance factors of safety among workers who have not undergone the training (Pre-training). Furthermore the same parameters were also assessed in the employees, 6 months, 12 months or 24 months after undergoing advanced "working at heights" training at Vertical Horizonz to evaluate how length of time (after training) impacts the effectiveness of the training. The study consisted of the following steps:

1. The first step of the study was to identify a commercial company in New Zealand that provides safety training. Vertical Horizonz, a multinational training provider that operates in New Zealand, was chosen as a training provider and collaborator for the study.
2. The next step was to identify the base line measures of safety knowledge, climate, culture and behaviour in workers who have not been trained before. For this purpose a training naïve cohort that had enrolled for "working at heights" training for the first

time at Vertical Horizonz was recruited into the study. This cohort was given the "pre-training" survey.

3. A cohort that had already undergone the training had to be identified to assess the impact of the training on improved safety practices in the workers. The objective was to assess the long term effectiveness of the training on worker's safety. Hence, three independent cohorts were chosen, and they were assessed after 4-6 months or 10-12 months or 22-24 months after the training using the "post-training" survey.
4. A review of literature was conducted to develop questionnaires that measure both base line and improvements after the training in safety knowledge, safety climate, safety culture, safety behaviour, minor injuries, facilitating and hindrance factors of safety among workers.
5. Following the development of the questionnaires, a pilot testing of the questionnaires was done on a limited number of pre and post-training participants. Based on the feedback, a further revision of the questionnaires was done for clarity.
6. While the pre-training survey was conducted using a hard copy, the post-training survey was performed online. Survey software *Qualtrics* was used to analyse the survey results.
7. The study was done according to the ethical standards approved by the Waikato Management School Ethics Committee, University of Waikato, Hamilton, New Zealand.

3.1.1 Questionnaire development

Despite the fact that Vertical Horizonz has offered this particular course of "working at heights" (which is in line with WorkSafe recommendations) for many years, it has never been evaluated thoroughly for effectiveness. Hence, it was deemed that a quantitate study was a reasonable design to investigate the effectiveness of the training course.

3.1.2 Use of questionnaire for measuring the effectiveness of the training

The design of the questionnaire to measure the effectiveness of the training was based on Realist Evaluation (RE) (Pawson and Tilley 1997). RE is a research based theoretical interventional approach developed for specific "context", "mechanisms" and "outcomes". In this study the specific "context" was the "working at heights" training program. The "mechanisms" used to measure the "context" are the improvements (or lack thereof) seen in safety knowledge and safety behaviour of the workers. The "outcome" of the study is the evaluation of the training effectiveness. One of the best ways to evaluate a training program is to learn from the past experiences of the training program. Determining the effectiveness of the training program will help identify successful parts of the program and which part of the training program needs improvement. Training evaluation improves VHNZ accountability to the concerned stake holders and determine if the company's objectives are accomplished. In summary, measuring the training effectiveness will help to improve the working at heights training program.

To measure the training effectiveness several different methods can be used. They include training specific quizzes, one-on-one discussions, employee based questionnaires/surveys, case studies, and official exams that can be used to certify. In this study, a quantitative employee based questionnaire was used to measure the training effectiveness. The common way of evaluating the effectiveness of a training course is to conduct a survey on the participants of the training program. This is because, the surveys are by far the simplest and most time- and cost-effective ways of establishing whether the training was effective in providing information and help in learning. It is preferred that the questionnaire be succinct where the answers can be graded on a scale to quantify the responses across the groups. As opposed to quantifiable questionnaires, asking open ended questions would result in a feedback that is very complicated to measure and quantify. Given

the positive attributes, the survey questionnaire was used to measure the effectiveness of "working at heights" training program. The concept of surveying participants with the questionnaire to measure the effectiveness of a training was first introduced by Don Kirkpatrick in 1959 and it has four-levels for evaluating training effectiveness. The first level measures the reaction of learners to the training and how useful the training was to the learner. The second level measures knowledge and skills gained by the learners and the third level measures how the training affected the learner's performance and attitude at work. Finally, the fourth level measures the tangible results of the training. Since the current survey was based on the Kirkpatrick Training Evaluation Model, all four levels of learning were measured using the post-training questionnaire.

The questionnaires were developed following a four-stage process: (1) Designing of the preliminary questionnaires (2) testing of the preliminary version of the questionnaires (3) incorporation of the comments and suggestions, and (4) development of the final version of the questionnaires. A sample of 100 questions was developed by extensively reviewing the project reports that measured the training effectiveness (Mustard, 2019). The final pilot sample questionnaire was prepared in consultations with the trainers/teachers of working at heights Advanced course. Given that the objective was to assess the training effectiveness, two distinct questionnaires were developed; the pre-training questionnaire was meant to obtain base line data for training naïve workers and the post-training questionnaire was meant for the workers who have undergone training previously.

3.1.3 Pilot testing of the questionnaires

The questionnaires were pilot tested at Vertical Horizonz on the participants who were undergoing "working at heights" Advanced training. The pre-training employee questionnaire was pilot tested on 10 employees who were undergoing "working at heights-Advanced" training. The post-training questionnaire was pilot tested with 10 employees

who had already undergone “working at heights” Advanced course. The proposed study details and the aims of the research project were explained to the participants and were assured of complete anonymity as names or any identification of the participants was not collected. Furthermore, it was explained to the participants that the participation was voluntary and the data were confidential. The pilot test was used to assess the clarity of the questions, the comprehension and time taken to answer the questions. Another aim was to judge if the questionnaire was too long. The feedback was used to revise the questionnaires.

3.1.4 Questionnaire variables

As mentioned above, two questionnaires, the pre-training and the post-training questionnaire were designed for this study.

3.1.4.1 Pre-training questionnaire

The pre-training questionnaire was designed to test the extent of prior knowledge of the workers before training. The questions were designed to understand the extent of knowledge they possessed in the following areas:

- Demographics
- Safety Knowledge
- Safety Behaviour
- Risk Acceptance
- Confidence
- Work Practice

Demographics

Participants were asked information on their age-group, gender, type of organisation they worked. In addition, the information regarding their prior work experience in working at heights, or if they had any formal training in “working at heights” was obtained. The information regarding their union affiliation and who paid for their training was also obtained.

Safety knowledge

To collect base line data for safety knowledge, three items were used and the responses were measured on a five factor scale. The three questions used in the pre-training questionnaire, measured work-specific knowledge. The questions included :

1. "how often do you maintain three-point contact when using a ladder"
2. "how often do you get job specific 'working at heights' training before the start of each job"
3. "to what extent are you expecting your heights training to be useful in doing your work?"

Safety Behaviour

The safety behaviour was assessed by three items. The three questions that were used in the questionnaire were,

1. "how often do you check the worksite for work at height hazards at the beginning of the shift?"

2. "how often do you inspect your height safety equipment before using it?"

3. "how often are you given the fall rescue plan before the start of each job?"

Safety Climate

The safety climate is dependent on three main factors which include:

- Risk Acceptance
- Work practices
- Confidence and awareness

Hence appropriate questions pertaining to these categories were included:

Risk Acceptance

One of the common problems encountered in the training naïve employees is their ability to accept the risk and accomplish the job since they are not aware of the consequences. Hence,

in the pre-training questionnaire, two key questions were asked to monitor the risk acceptance of the participants.

1. "how often do you work without suitable height safety equipment?"
2. "how often do you take a shortcut to save time, even though it increases chances of injury?"

Work Practices

Safety culture is clearly indicated by the work practices. In the questionnaire, two questions were included to monitor the baseline data on the prior safety practices .

1. "how often do you use guardrails instead of a fall arrest system?"

2. "how often do you use seat belts when travelling to, from or around worksites?"

Confidence

Confidently performing work at heights is due to good common-sense knowledge about safety. Hence, two questions were included to monitor the confidence of the participants who do not have any prior training. The questions were:

1. "how often would you raise your safety concerns in meeting with your supervisor/manager?"

2. "how often would you raise your safety concerns with your co-worker?"

3.1.4.2 Post-training questionnaire

The post-training questionnaire, was designed to analyse how effective the training was in improving safety practices of the employees working at heights. The post-training questionnaire was tested on the employees who had gone through the training. In the same study, the long term effectiveness of the training was also tested on participants who had completed training 6 months, 12 months or 24 months before taking part in the survey. Impact on different aspects of the safety that were tested included:

- Safety Knowledge

- Safety Behaviour
- Confidence and Awareness
- Safety Commitment
- Risk Acceptance
- Work Practices
- Risk and Accident Reduction
- Hindrance Factors
- Facilitators

Safety Knowledge

This was assessed by eight items which asked about the employee awareness and understanding of the safety procedures. Example items are 'training improved my knowledge about using ladders safely", "training improved my knowledge about when to attach to a height safety system", and "training improved my knowledge in identifying suitable anchor points".

Safety Behaviour

The safety behaviour included six items and the questions were related to compliance and participation. The examples of safety behaviour item included " I will change the way I take safety precautions", "I assess height safety risks before beginning a job", and "I inspect all height safety equipment before beginning a job".

Confidence and Awareness

The confidence and awareness topic included six items. The questions were related to increase in confidence and awareness as a result of the training. The examples of confidence and awareness include " I am confident in applying the height safety skills", "I am now confident that my height safety practices are legally compliant", and "confident of stopping a colleague from doing an unsafe height safety practice".

Safety Commitment

Commitment to safety is paramount to develop good safety climate in a company and it is believed that training improves commitment among workers. Hence, four items have been

included in the questionnaire. The examples of safety commitment questions are " I am not embarrassed to ask a safety question", "I now consider safety more important than getting the job done quickly", and "I now report unsafe practices whenever I see them".

Risk Acceptance

Continuing to work at heights by accepting risks and ignoring hazards is a clear indication of lack of safety knowledge and/or existence of poor safety climate. Both factors clearly indicate the ineffectiveness of training. Hence three items were included in the questionnaire to test the ability to accept risks by the trained workers. The examples of risk acceptance questions are " I perform jobs for which I do not have required knowledge/training", "If PPE is not made available to me, I work without them", and "I work without all necessary protection to increase my productivity".

Work Practices

Good safe work practices stem from thorough understanding of safety legislation, commitment to safety and prevailing good safety climate. Safety training has been shown to positively influence good work practices and therefore, in this questionnaire, 7 items were included to monitor how training affects work practices. The examples of work practices are " how often have you used height safety protection equipment that has expired", "how often have you maintained three-point contact when using a ladder", and "how often have you been taking shortcuts to save time, even though there was a chance of falling".

Risk and Accident Reduction

Making a concerted effort to reduce unsafe practices is a clear indication of understanding of safety and hazards. Therefore, 5 items were included in the questionnaire. The examples of risk and accident reduction are " I do not take even small risks that can lead to accidents", "I do not perform jobs for which I do not have required knowledge/training", and "I do not work without PPE".

Hindrance Factors

It is a fact that lack of support generally hinders the implementation of safety regulations. Therefore, one of the aims in the questionnaire was to find out if the training overcomes the hindrance factors in a company for successful implementation of the safety rules. There were in total 12 items included in the hindrance factors. Three different hindrance factors, such as, Personal hindrance factors (example: "I find it hard to apply what I learned in the training, because there is too much to remember"), Time hindrance (example: "I find it hard to apply what I learned in the 'working at heights' training, because I don't have the time to inspect my fall protection equipment before using it"), Work place environment hindrance (example: "I don't follow fall prevention procedures learned in the 'working at heights' training because of my supervisor's relaxed attitude") were tested.

Facilitators

Facilitating factors allow for successful implementation of the safety rules in a company. Therefore, the impact of training in development of facilitating factors for the implementation of the safety rules by the employees was tested by including 14 items. Four different facilitating factors, Resource factors (example: "Adequate money is available to purchase and use safety equipment at my work"), Management factors (example: "Our management strictly enforces height safety regulations"), Personal factors (example: "I am aware that I need to follow height safety rules when I am working at heights"), Relationship factors (example: "Co-workers encourage each other to follow safety and fall prevention protocols at my company") were tested.

3.2 Sample

The participants of this study were all recruited from Vertical Horizonz database. The participants of the pre-training cohort were the employees who had enrolled for the 2-day "working at heights Advanced" training course at Vertical Horizonz, New Zealand. Before

the start of the course on day 1, the participants were given the proposed study details. Furthermore, the aims of the research project were explained to the participants and were assured of complete anonymity as names or any identification of the participants were not collected. In addition, it was explained to the participants that the participation was voluntary and the data were confidential. After the announcement, a hard copy of the pre-training questionnaire (containing the consent for the use of data in research) was circulated and the hard copy responses were collected. The survey results were entered into the *Qualtrics* for analysis.

For conducting the post-training survey, 3640 trainees who had completed "working at heights Advanced" course were chosen from the Vertical Horizonz database and were invited to participate in the post-training survey. The participants were classed into three groups (i) Group 1, where the respondents had completed the training 4-6 months before the survey (1071 trainees) (ii) Group 2 where the respondents had completed the training 10-14 months before the survey (1016 trainees) and (iii) where the respondents had completed the training 22-26 months before the survey (1553 trainees). The post-training questionnaire (containing the consent for the use of data in research) and the participant information sheet was distributed electronically via the survey software *Qualtrics*. The information sheet outlined the research aims, what would be required of them if they wished to participate, explained the anonymity and confidentiality of the data.

The participants were sent two reminders for the completion of the survey. The trainees for this study (including pre and post-training) came from a variety of industries that include construction, renewable energy, and chemical industry. The other demographic details about the participants are described in the results section.

Ethical approval for this research was granted by the Waikato Management School Research and Ethics Committee, University of Waikato, Hamilton, New Zealand.

3.3 Data analysis

Multiple data analyses were conducted on the results collected. The data were collected and stored via the software Qualtrics. The demographic data and other survey results of pre and post-training cohorts were exported to the spreadsheet "Numbers" (Apple) and analysed. The data corresponding to the percentage of respondents and their answers (such as "always" "never" "sometimes" "occasionally") to different questions were downloaded from Qualtrics directly into "Numbers" to generate bar graphs. The mean for the data for both pre and post-training responses on safety knowledge, safety behaviour, confidence and awareness, risk acceptance and work practices were calculated for comparisons.

4 Chapter Four: Results

4.1 Participants

Table 1 represents the number of participants in the pre-training and post-training surveys. The pre-training questionnaire was circulated among the trainees (participants) on the first day before the beginning of the training. Sixty eight workers who took part in the survey returned the form, making it a 100% successful response. However, the response rate of the post-training survey was only ~10%. The possible reason for the low post-training survey could be due to the fact that the survey was conducted online using Qualtrics.

4.2 Demographic analysis

Tables 2-5 contain demographic data of the pre-training and post-training survey participants. The data show that 90% of the pre-training survey respondents were male and only 10% were female (Table 2). While the highest percentage of the employees who took the pre-training survey (32%) were between the ages of 25-34, very young (15-24 years old), and mature participants (35-44 years old) were found to be 28% and 27% respectively. Among the pre-training respondents, about half of them (56%) worked in the construction industry, while the rest of the respondents worked in different industries that involved working at heights. While 29% of the pre-training survey participants had "moderate" level of experience in working at heights, 40% of them had little (27%) to no experience (13%) in working at heights. It is interesting to note that 31% of the participants had a lot (15%) to great deal (16%) experience in working at heights (Table 2).

The post-training survey showed similar trends. A high number (88-96%) of the participants of the post-training survey ware male (Table 3-5). Unlike the pre-training survey, the highest number of the participants of the post-training survey happened to be in 45-54 years age group for the 6 Months and 12 Months post-training survey groups. But for the 24 Months post-training survey group, the largest number of the participants came from 35-44 years age group.

Table 1: Summary of Pre and Post-training Surveys

Time Point	Total Distributed	Response Received	Percentage of completion
Pre-training	68	68	100
Post-training:			
6 Months	1071	109	10.2%
12 Months	1016	108	10.6%
24 Months	1553	139	9%

Table 2: Demographic Data of Pre-training Group

Gender

Gender	%	Count
Male	90	61
Female	10	7

Age

Answer	%	Count
Under 15 years	0	0
15 to 24 years	28	19
25 to 34 years	32	22
35 to 44 years	27	18
45 to 54 years	6	4
55 to 64 years	7	5
65 years and over	0	0

Profession

Answer	%	Count
Financial and Insurance Services	0	0
Arts, Recreation and Other Services	2	1
Manufacturing	10	7
Electricity, Gas, Water and Waste Services	15	10
Construction	56	38
Wholesale Trade	6	4
Retail Trade and Accommodation	1	1
Transport, Postal and Warehousing	1	1
Information Media and Telecommunications	3	2
Rental, Hiring and Real Estate Services	2	1
Professional, Scientific, Technical, Administrative and Support Services	2	1
Public Administration and Safety	2	1
Health Care and Social Assistance	1	1

Experience in working at height

Answer	%	Count
A great deal	16	11
A lot	15	10
A moderate amount	29	20
A little	27	18
None at all	13	9

Again majority of the participants of the post-training survey came from construction industry. As expected higher number of the post-training participants had a "Great deal" of knowledge of working at heights (Table 3-5).

4.3 Safety Knowledge

In the pre-training questionnaire, 3 questions regarding safety knowledge were included to test the basic safety knowledge of the participants (Figure 1). The responses showed that, around 50% of the participants "always" maintained the required 3 point contact for the ladder and thereby indicated that a significant number of participants knew how to use a ladder safely even before proper training. A total of 15% replied that they "occasionally" or "never" maintained 3-point contact while 28% "usually" maintained the 3-point contact for the ladder. In response to another knowledge question, surprisingly ~30% of the participants answered that they "never" get "job specific heights training" before the start of the work, indicating that a significant number of workers do not have job specific training of working at heights and are at risk of not having appropriate safety knowledge. When the participants were questioned if the training was going to be useful, a high number of the participants (65%) replied that it was going to be "extremely useful". In summary, the pre-training survey shows that while the participants have common sense fundamental knowledge about working at heights (such as ladder usage), a high proportion of the workers did not have job specific training of working at heights (Figure 1).

In the post-training questionnaire, an effort was made to decipher if the heights training offered at Vertical Horizonz, did indeed impart the new knowledge about the heights training, working safely and improve the technical skills such as selecting appropriate equipment, tying appropriate knots required to work at heights. All together there were 8 questions. The survey results suggest that in all three groups (6 Months, 12 Months and 24 Months), overwhelming number of respondents (~85-90%) agree (strongly agree or agree) that training did indeed help

Table 3: Demographic Data of 6 Months Post-training Group

Gender

Answer	%	Count
Male	88	67
Female	12	9

Age

Answer	%	Count
Under 15 years	0	0
15 to 24 years	13	10
25 to 34 years	21	16
35 to 44 years	18	14
45 to 54 years	30	23
55 to 64 years	17	13
65 years and over	1	1

Profession

Answer	%	Count
Arts, Recreation and Other Services	9	7
Manufacturing	24	18
Electricity, Gas, Water and Waste Services	13	10
Construction	32	24
Wholesale Trade	3	2
Transport, Postal and Warehousing	9	7
Information Media and Telecommunications	1	1
Professional, Scientific, Technical, Administrative and Support Services	4	3
Education and Training	3	2
Health Care and Social Assistance	1	1

Experience in working at heights

Answer	%	Count
A lot	25	19
A moderate amount	40	31
A little	31	24
Not at all	4	3

Table 4: Demographic Data of 12 Months Post-training Group

Gender

Answer	%	Count
Male	96	72
Female	4	3

Age

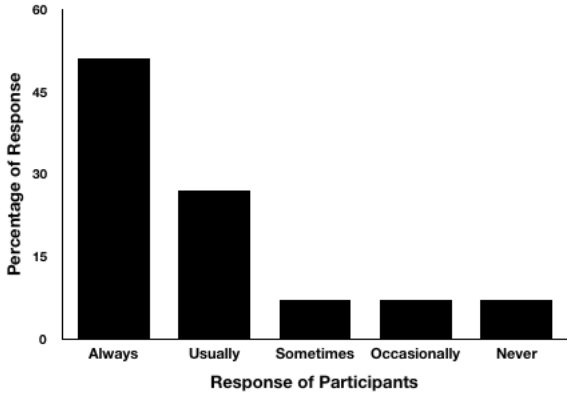
Answer	%	Count
Under 15 years	1	1
15 to 24 years	8	6
25 to 34 years	18	14
35 to 44 years	25	19
45 to 54 years	32	24
55 to 64 years	13	10
65 years and over	3	2

Profession

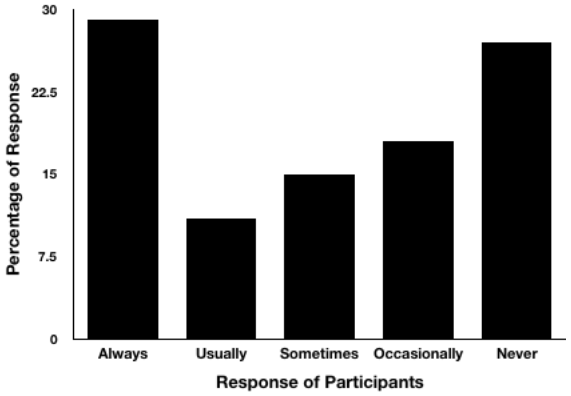
Answer	%	Count
Manufacturing	17	13
Electricity, Gas, Water and Waste Services	25	19
Construction	32	24
Transport, Postal and Warehousing	7	5
Information Media and Telecommunications	7	5
Professional, Scientific, Technical, Administrative and Support Services	7	5
Public Administration and Safety	1	1
Education and Training	4	3

Experience in working at heights

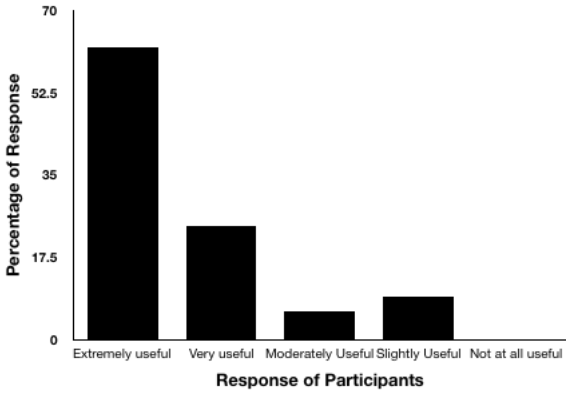
Answer	%	Count
A lot	41	31
A moderate amount	36	27
A little	22	17
Not at all	1	1



At present, how often do you maintain three-point contact when using a ladder?



At present, how often do you get job specific 'working at heights' training before the start of each job?



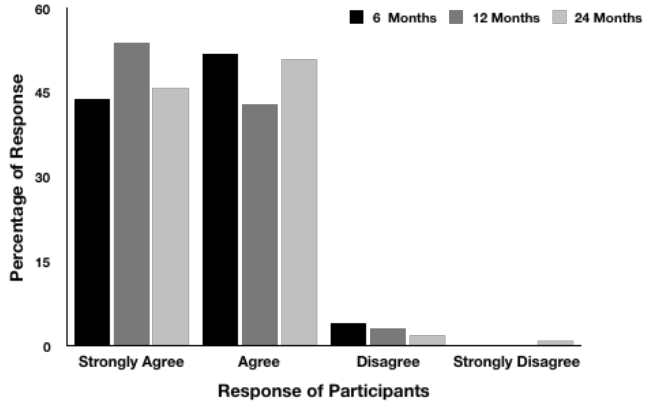
To what extent are you expecting your heights training to be useful in doing your work?

Figure 1: Pre-training Safety Knowledge survey. Percentage breakdown of responses by the pre-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

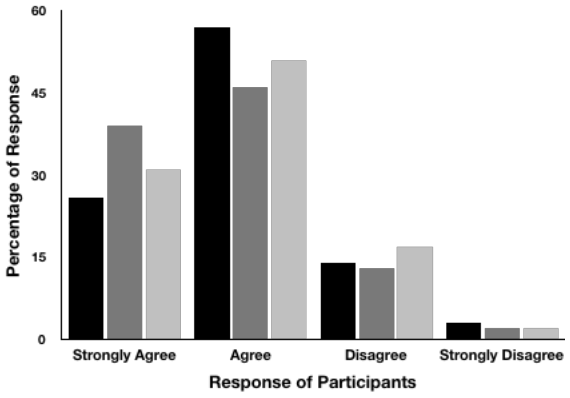
them to learn new information and improved their knowledge in (i) how to use ladders (ii) attach height safety system (iii) identify suitable anchor points (iv) safety practices (v) tying appropriate knots. Albeit a small proportion, 5 to 15% of the respondents, disagreed that training helped them gain new knowledge or improved their knowledge about the safe use of ladders. When the mean responses across all the 8 questions of the post-training results were calculated, ~92% of the surveyed workers "agreed" or "strongly agreed" that the training helped them improve their knowledge as opposed to 68% of the pre-trained workers who responded that they "always' or "usually" follow the safety protocols due to pre-existing safety knowledge. These results clearly establish that the majority of the participants agree that working at heights course (offered by VHNZ) was adequately designed to impart practical, technical and theoretical knowledge about working at heights (Figure 2 and Figure 3). In summary, it can be concluded that the training is effective in improving the safety knowledge among workers. No major difference in the level of safety knowledge was seen among the three post-training groups (6 Months, 12 Months and 24 Months).

4.4 Safety Behaviour

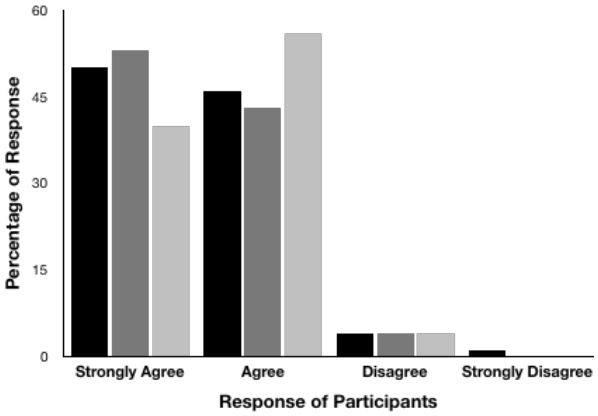
Three questions that test the safety behaviour of the workers were included in the pre-training questionnaire. Checking for hazards before the start of work is a good safety behaviour as it would reduce injury, therefore the participants were asked "how often do you check the worksite for work at height hazards at the beginning of the shift?". While ~45% of the participants expressed that they "always" check for the hazards, close to 9% of the participants mentioned that they "never" check for the hazards (Figure 4). The responses also indicate that another 9% "occasionally" check for the hazards. In response to the second safety behaviour question, "how often do you inspect your height safety equipment before using it?" similar pattern of responses was observed. While 45% maintained that they "always" check the equipment before using it, close to 20% of the respondents maintained that they either "never"



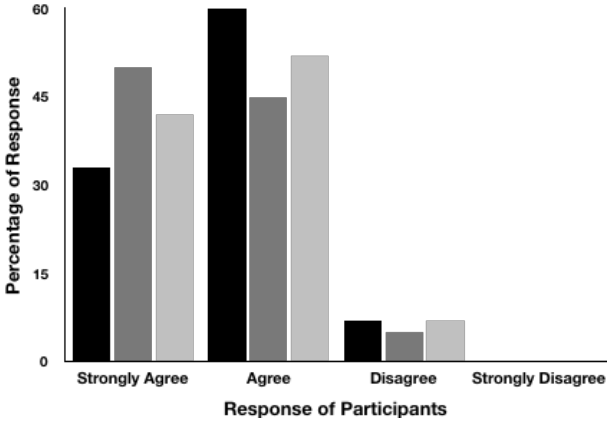
"I learnt new information about how to work safely at heights"



"The training improved my knowledge about using ladders safely."



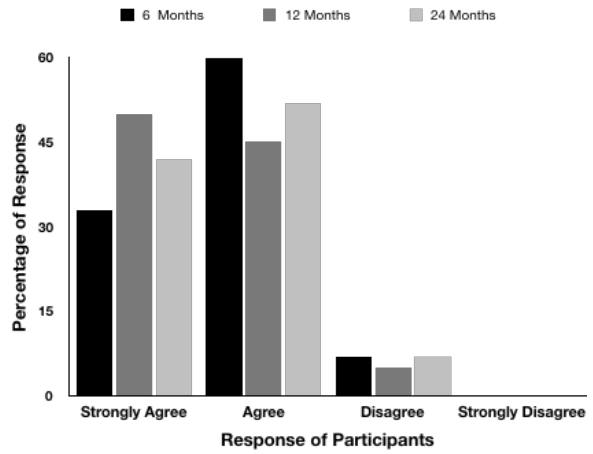
"The training improved my knowledge how to attach to a height safety system"

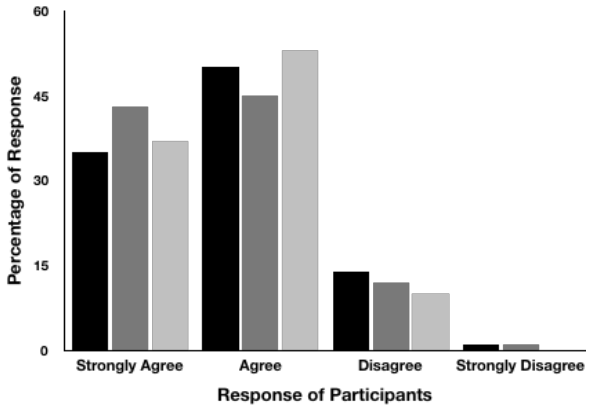


"The training improved my knowledge in identifying suitable anchor points"

Figure 2: Post-training Safety Knowledge survey

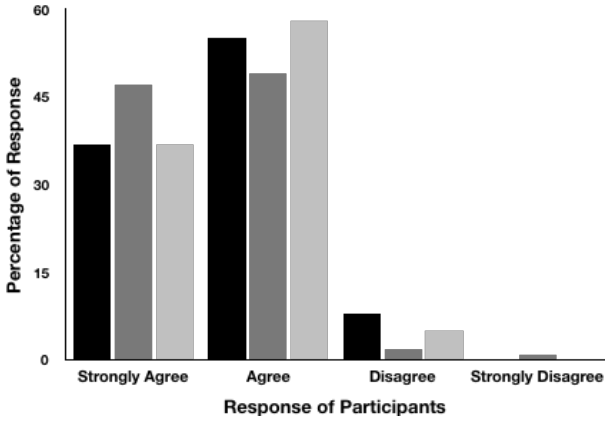
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

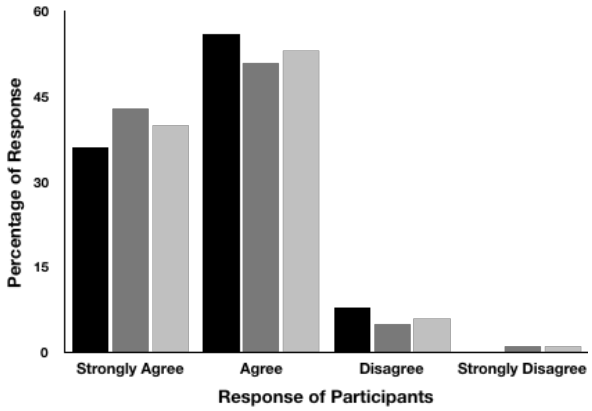




The training improved my knowledge about general safety practices.

The training improved my knowledge when selecting and tying an appropriate knot.



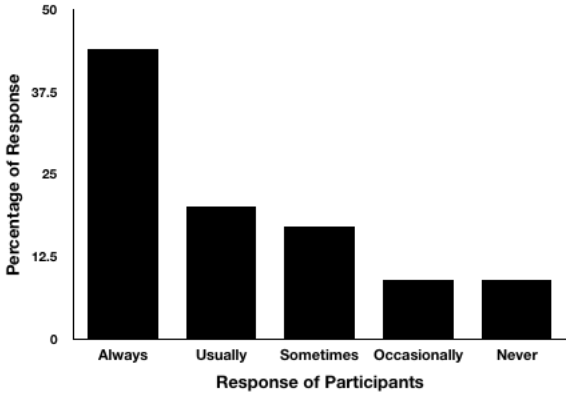


"The training improved my knowledge when selecting a height safety system"

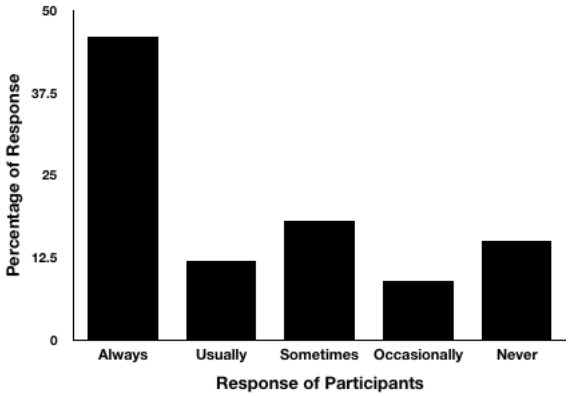
"The training improved my knowledge about selecting height safety equipment for different scenarios"

Figure 3: Post-training Safety Knowledge survey.

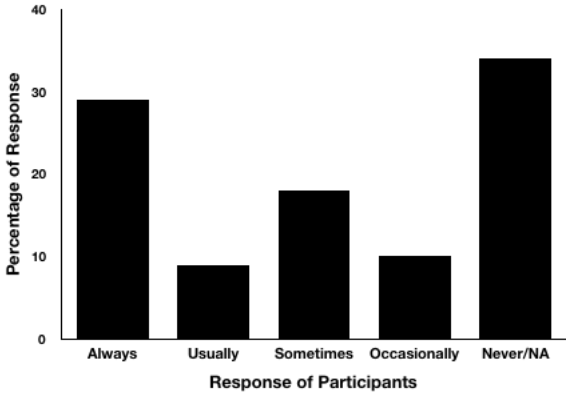
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



At present, how often do you check the worksite for work at height hazards at the beginning of the shift?



At present, how often do you inspect your height safety equipment before using it?

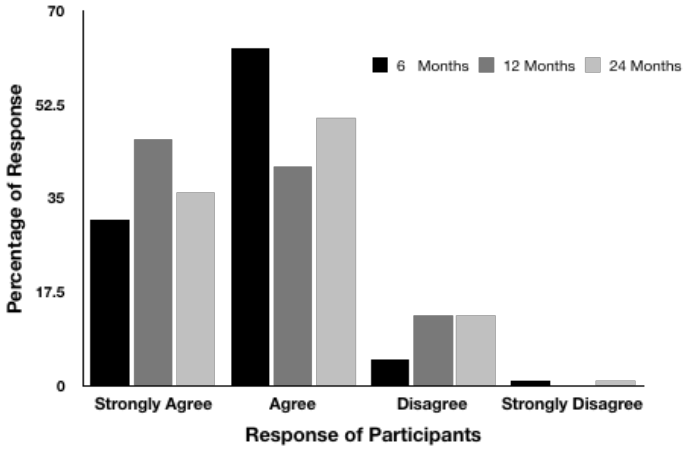


At present, how often are you given the fall rescue plan before the start of each job?

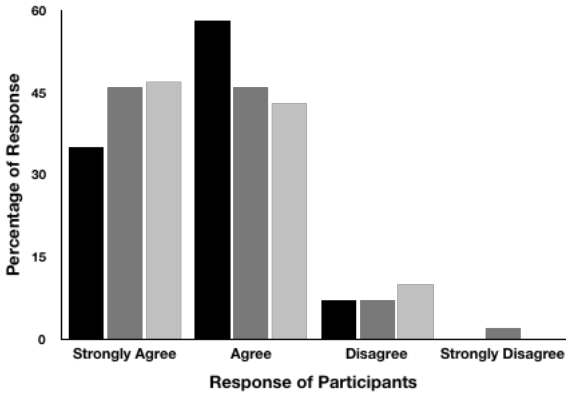
Figure 4 : Pre-training Safety Behaviour survey
Percentage breakdown of responses by the pre-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

or “occasionally” check the safety equipment before using it. Finally, the third question was to test the most important aspect of the safety behaviour that is having a “fall rescue” plan before the start of a job. Close to 35% of the workers who have not undergone the training, replied that they were “never” given fall rescue plan. However, it is noteworthy that ~30% of the participants had a fall rescue plan before the start of the job (Figure 4). Collectively, these results clearly indicate that a significant proportion of the workers are not aware of key issues regarding the safety behaviour and perhaps the training would lead to an improvement in their safety behaviour.

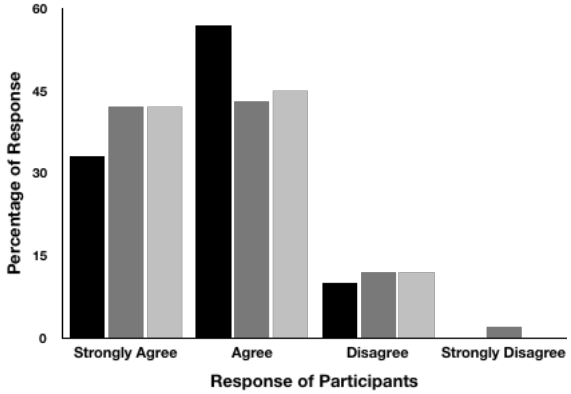
In the post-training questionnaire, 6 key questions regarding safety behaviour were included. First four questions tested, if as a result of the training, some of the basic elements of the safety behaviour were inculcated in the participants. Specifically, the behaviours tested were “I will change the way I take safety precautions”, “I assess height safety risks before beginning a job”, “I inspect all height safety equipment before beginning a job” and “I assess the need for a rescue plan before beginning a job”. The results suggested that 85-90% of the respondents “agreed” or “strongly agreed” with four safety behaviours mentioned above. But it is noteworthy that close to 10% of the respondents disagreed with the safety behaviours (Figure 5 and Figure 6). When the response to the question “I will change the way I take safety precautions” was compared among the three post-training groups, a higher number of respondents (13% Vs 5%) in 12 Months and 24 Months group “disagreed” with this statement. In addition, questions 5 and 6 tested the safety behaviours such as “ordering new safety equipment” and wearing “an industrial helmet while working at height” that will improve safety of the workers around work site. The results show that 45% disagreed with the fact that they ordered new safety equipment. Furthermore, 25% of the respondents mentioned that they “disagree” with the fact that they wore industrial grade helmet while working at heights (Figure 6).



As a result of heights training, I will change the way I take safety precautions

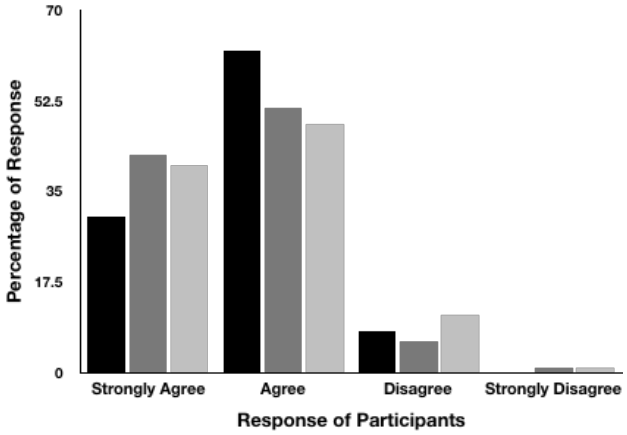


As a result of heights training, I assess height safety risks before beginning a job

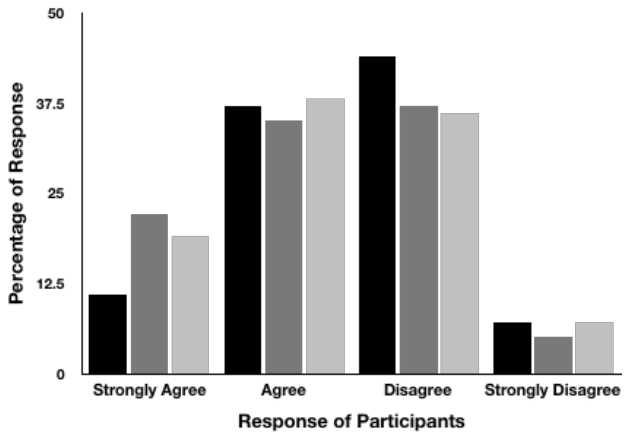


As a result of heights training, I inspect all height safety equipment before beginning a job

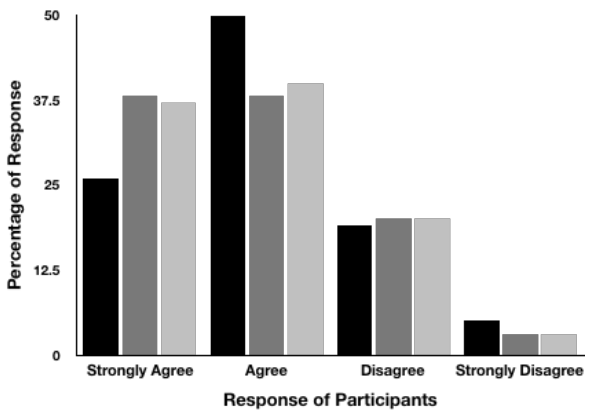
Figure 5: Post-training Safety Behaviour survey
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



As a result of heights training, I assess the need for a rescue plan before beginning a job



As a result of heights training, I have ordered new height safety equipment.



As a result of heights training, I use an industrial safety helmet when conducting work at heights.

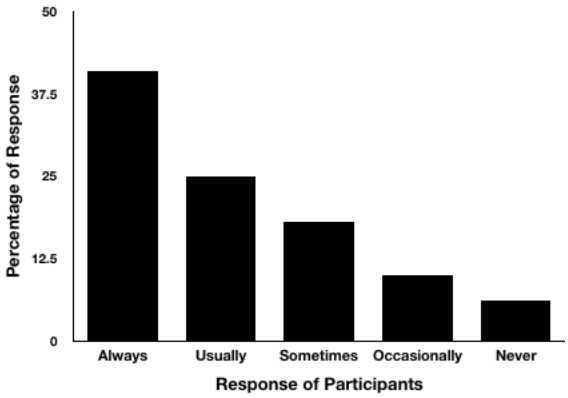
Figure 6: Post-training Safety Behaviour survey
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants are shown on the X-axis.

When the mean of responses to all the safety behaviour questions were calculated, only ~53% of the pre-training workers mentioned that they "always" or "usually" had adapted safety behaviour. In contrast a significantly higher number of ~82% "agreed" or "strongly agreed" that the training had helped them to improve their safety behaviour. This improvement in the positive response after the training to the safety behaviour questions clearly demonstrates that the VHNZ designed working at heights training is effective in improving the safety behaviour of the employees.

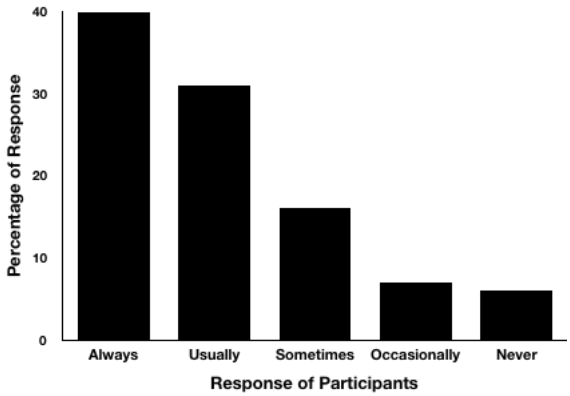
4.5 Confidence and awareness

Having confidence to implement health and safety regulations, or reporting safety concerns to the managers or raise them with colleagues is a proxy for the confidence and awareness of the employees. Hence, two questions were included in the pre-training survey to evaluate the level of confidence in the employees. The survey results indicate that around 40% of the respondents would "always" "raise safety concerns in a meeting with supervisor" and only ~13% of the respondents would "never" or "occasionally" raise them with managers (Figure 7). Similarly, 40% of the respondents mentioned that they would "always" raise their concerns with colleagues and around ~10% would "never" or "occasionally" raise their safety concerns with colleagues (Figure 7) .

Since having confidence is a key component of the health and safety practice at work, 6 questions were included in the post-training questionnaire to measure the confidence of the workers after the training. The six questions tested the confident nature of the participants not only in technical knowledge but also in their interactions with colleagues and managers. The survey indicates that about 90% of the respondents agree (strongly agree and agree) that they are confident in "applying the height safety skills" they learnt in the training (Figure 8). Furthermore, 90% of respondents agree (strongly agree and agree) that they are confident that their "height safety practices are legally compliant" suggesting that the training has imparted

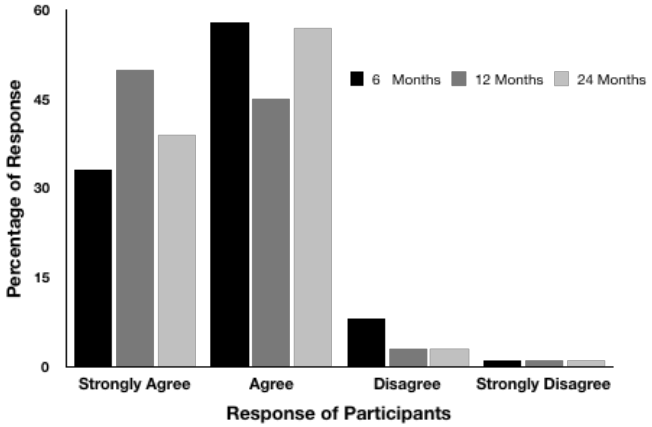


At present, how often would you raise your safety concerns in meeting with your supervisor/manager?

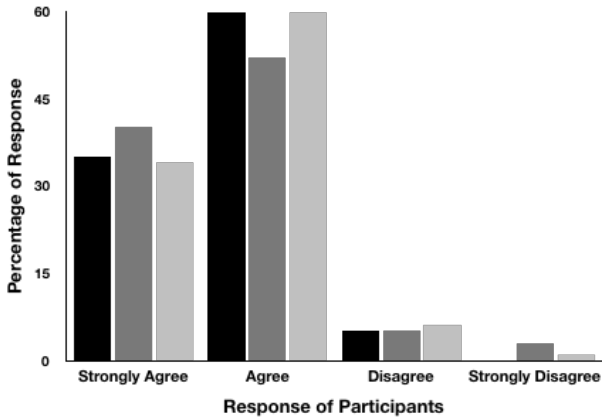


At present, how often would you raise your safety concerns with your co-worker?

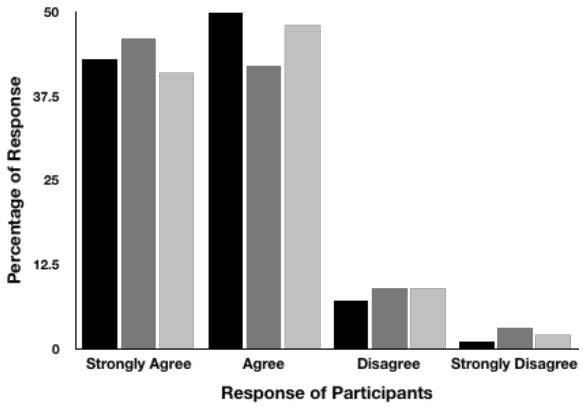
Figure 7: Pre-training Confidence and Awareness survey
Percentage breakdown of responses by the pre-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



As a result of heights training, I am confident in applying the height safety skills.

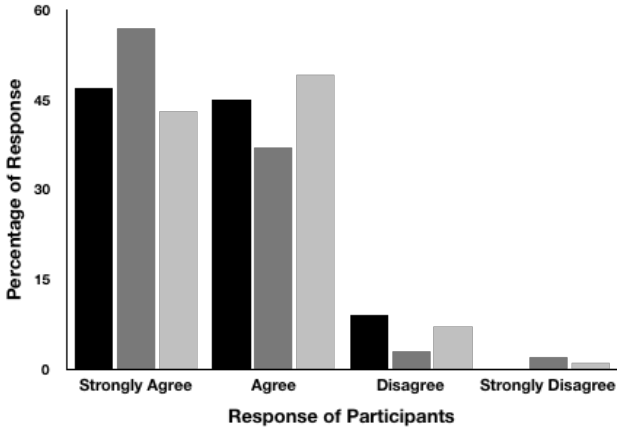


As a result of heights training, I am now confident that my height safety practices are legally compliant.

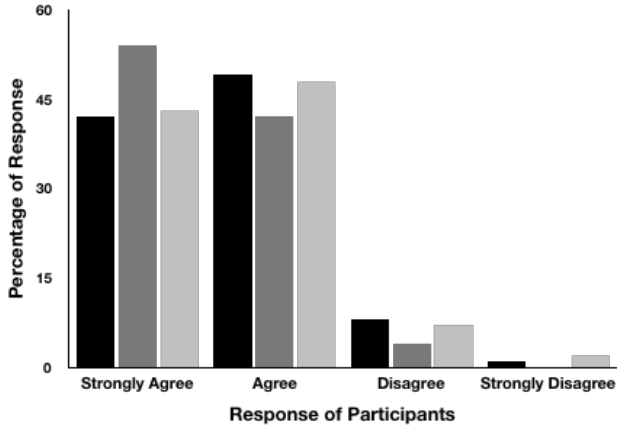


As a result of heights training, I am now confident of raising safety concerns with my supervisor or manager.

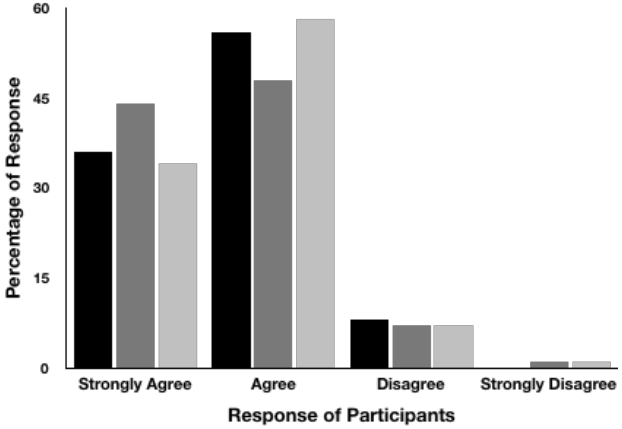
Figure 8: Post-training Confidence and Awareness survey
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



As a result of heights training, I am now confident of stopping a colleague from doing an unsafe height safety practice.



As a result of heights training, I feel confident fitting a height safety harness.



As a result of heights training, I feel confident about identifying whether height safety equipment adheres to relevant standards.

Figure 9: Post-training Confidence and Awareness survey
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

the relevant knowledge. A further two questions confirm that majority of the trainees who participated in the survey are very confident. The results show that 90% of the respondent agree (strongly agree and agree) that they are confident of raising safety concerns with their supervisors/managers (Figure 8). In addition, 90% of the respondent also agree (strongly agree and agree) that they have no hesitation in "stopping a colleague from doing an unsafe height safety practice**"** (Figure 9) . Further two questions tested the confidence of the participants in their technical ability. In response to the question if the trainees are confident of "fitting a height safety harness", 90% of them responded positively (Figure 9)**.** One of the key factors that tests the confidence of employees is the ability to select proper equipment that is of appropriate standard. Hence, in the next question, the ability to choose proper equipment of appropriate standard was tested. Consistent with other confidence parameters, a resounding 90% of the respondents agree that they are confident of "identifying whether height safety equipment adheres to relevant standards" (Figure 9). To investigate, if the training was effective in improving the confidence, and awareness of the safety regulations, the mean values of the responses to the confidence and awareness questions were generated for both pre and post-training surveys. The results show that while 68% of the pre-training respondents "always" or "usually" have the confidence in discussing the safety regulations with supervisors and/or colleagues, before training, ~92% of the workers who have undergone training responded that they "agree" or "strongly agree" that the training has made them aware of the safety regulations and given them confidence to discuss the safety regulations with supervisors and co-workers. These results further confirm that the training is effective in improving the awareness of the safety regulations and improving the worker's confidence. The results also show that there is no significant difference in awareness or confidence between the three post-training groups (6 Months, 12 Months and 24 Months). In summary, the survey confirms that the training has imparted a well-rounded safety knowledge and as a result the participants are

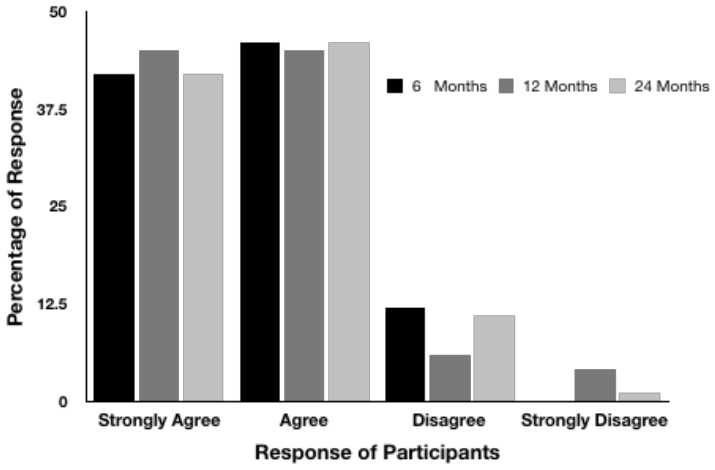
confident of their safety practices and are well aware of technical, legal and basic knowledge of the safety regulations pertaining to working at heights.

4.6 Safety Commitment

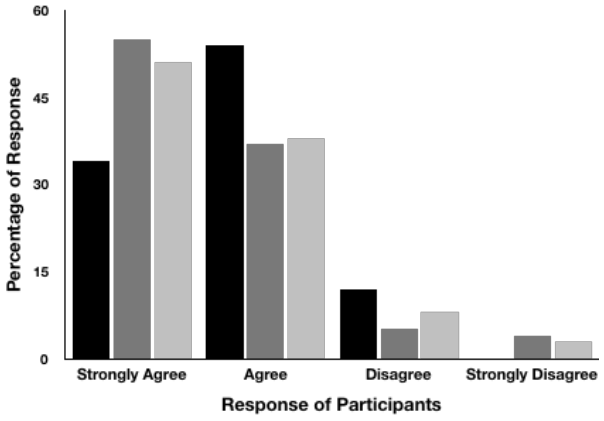
A safe work place leads to productive environment. To create work place safety, a whole hearted commitment is required from all employees. Five areas that define safety commitment are total compliance of the safety law, and going beyond just following the law, proactively identifying the hazards and ensuring that co-workers follow the regulations. To test these aspects of commitment to safety by the trained workers, four questions were included in the post-training questionnaire.

Sometimes the employees are embarrassed to get clarification of the safety regulations. However, training and therefore, commitment to safety at workplace, enables an employee to overcome embarrassment and seek the required clarification. Therefore, the first question was framed to find out if the employees were "embarrassed to ask a safety question". The survey results show that after the training ~ 90% of the participants agree (strongly agree and agree) that they were not embarrassed to ask questions about safety (Figure 10). In day to day life of employees, they are preoccupied to get the job done, hence the health and safety has the danger of taking a back seat to getting the job done. Hence, another question was to find out if the employees felt whether following the safety regulations is more important than getting the job done quickly. Approximately 85% of the respondents agree (strongly agree and agree) with the statement (Figure 10). However, it is noteworthy that 10% of the respondents do disagree that following safety regulations is more important than getting the job done quickly. In other words the 10% of the respondents believe that getting a job done quickly is more important than following the safety regulations.

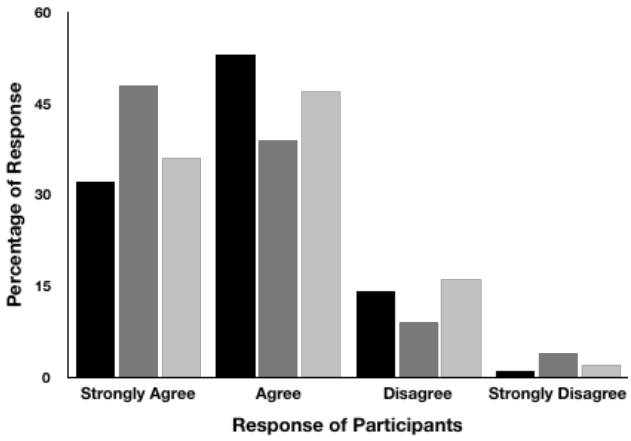
Another way an employee can show the commitment to safety at work is to make sure that there is a good safety environment and report any unsafe work practices. Hence, the third



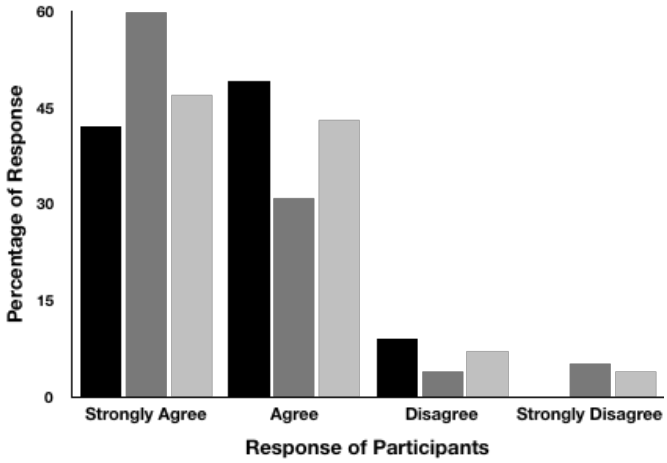
As a result of heights training, I am not embarrassed to ask a safety question.



As a result of heights training, I now consider safety more important than getting the job done quickly.



As a result of heights training, I now report unsafe practices whenever I see them



As a result of heights training, I believe that safety rules cannot be disregarded even when nearing the end of the shift.

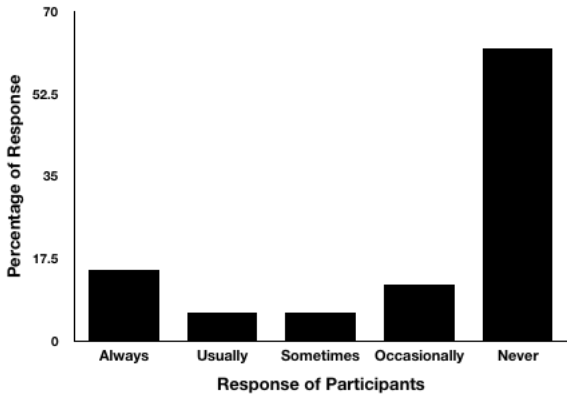
Figure 10: Post-training Safety Commitment survey
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

question in the post-training questionnaire was to find out if the participants of the survey report unsafe practices at work if they see any. The results show that 83-87% of the survey participants agree (strongly agree and agree) that they report unsafe work practices. However, 13-18% responded that they do not report unsafe practices in all three groups. Total commitment to safety means following the safety regulations at all times including towards the end of a working day. Hence, the final question verified if the employees believed that "safety rules cannot be disregarded even when nearing the end of the shift". The responses suggest that as a result of the training, majority of the employees (~90%) surveyed agree (strongly agree and agree) with the concept (Figure 10). No major differences in the responses to all four safety commitment questions were observed among the three post-training groups.

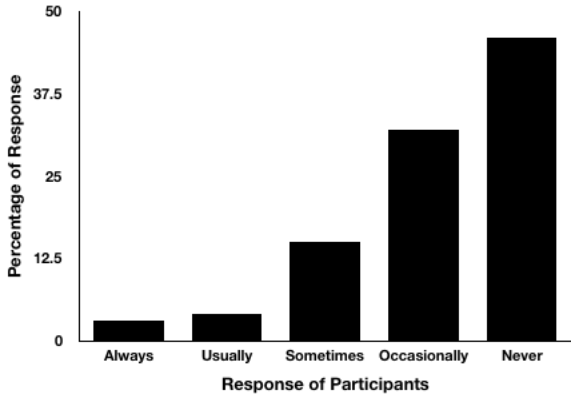
In summary, between 85-90% respondents of the post-training survey confirmed that due to the training, they have realized that safety commitment is their priority and that it takes precedence over getting the job done quickly or for that matter, following the safety regulations towards the end of the day, is equally important. Therefore, this part of the survey results clearly demonstrate that the training is effective in improving the safety commitment of the employees.

4.7 Risk Acceptance

Accepting risks at work creates a hazardous situation and leads to a substandard safety environment. Hence, questions were included both in the pre and post-training questionnaires to test if the training improved the safety conscience and reduced risk acceptance in the workers. In the pre-training questionnaire, when the trainees were asked if they "work without suitable height safety equipment?" a high percentage (~60%) replied "Never" and another ~12% mentioned "occasionally" (Figure 11). The same cohort when asked if they took " a shortcut to save time, even though it increases chances of injury" 48% replied that they "never"



At present, how often do you work without suitable height safety equipment?



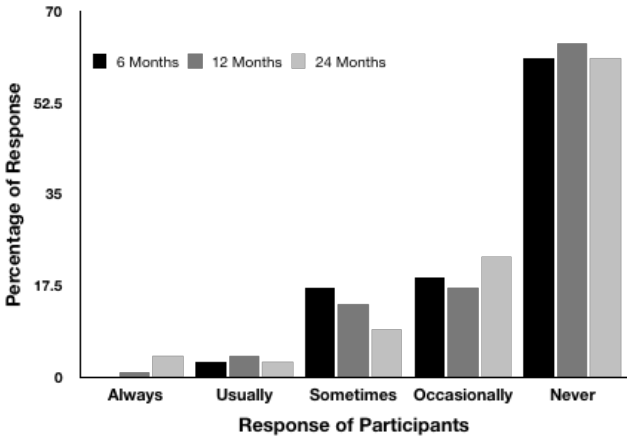
At present, how often do you take a shortcut to save time, even though it increases chances of injury?

Figure 11: Pre-training Risk Acceptance survey

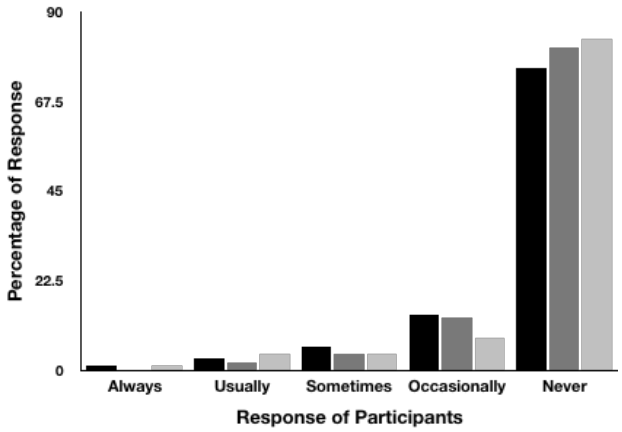
Percentage breakdown of responses by the pre-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

took shortcuts to save time. It is interesting to note, however, that a significantly higher number of the same cohort were taking/accepting risks as ~30% of the pre-training cohort answered that they were occasionally taking short cuts to save time (Figure 11).

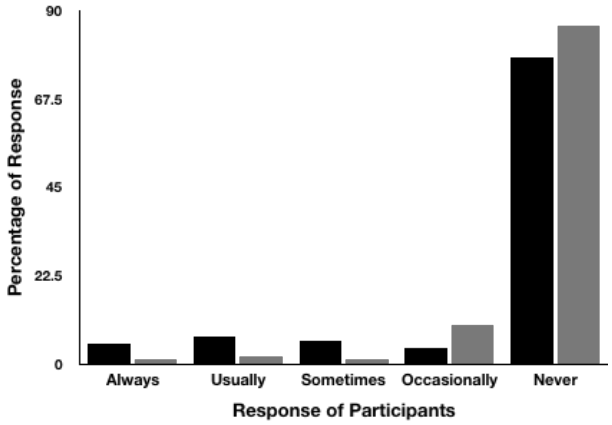
In the post-training questionnaire, three risk acceptance questions were included. When asked if the employees performed jobs for which they "do not have required knowledge/training", majority of them (~62%) replied "never" (Figure 12). However, it is noteworthy that close to 20% of them replied they do perform jobs without training "occasionally" and around 15% replied that they do it "sometimes" (Figure 12). In response to the question if they work without PPE if it is not available, close to ~80% respondents indicated that they would "never". However, ~10% respondents did mention that they "occasionally" worked without PPE if it was not available. Given productivity is a major focus at work, a question regarding compromising the safety for productivity was included in the questionnaire. About 80% of the respondents mentioned that they would "never" work "without all necessary protection to increase productivity". Only ~10% responded that they "occasionally" or "sometimes" performed jobs without all necessary protection to increase productivity (Figure 12). It is noteworthy that entire 24 Months group did not respond to this particular question. It could be due to a glitch in the Qualtrics system. In order to further investigate if the training is effective in reducing risky behaviour by the employees, the mean values of responses by the pre-training and post-training employees to the risk acceptance questions were compared. The results suggest that, because of the training there is an increase from 76% (pre-training) to 87% (post-training) in the cohort that rejected the risky behaviour with a concomitant decrease from 14% (pre-training) to 5% (pre-training) in the cohort that "always" or "usually" displayed the risky behaviour. These results confirm that the training is effective in reducing the risky behaviour of the employees and therefore improving the safety



I perform jobs for which I do not have required knowledge/training.



If PPE is not made available to me, I work without them.



I work without all necessary protection to increase my productivity.

Figure 12: Post-training Risk Acceptance survey

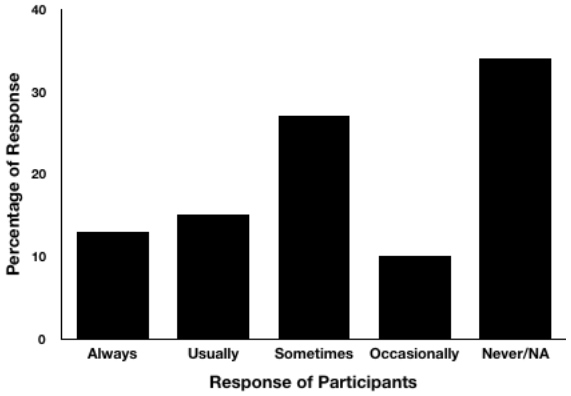
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

behaviour. No major differences in the responses to all three risk acceptance questions were observed among the three post-training groups.

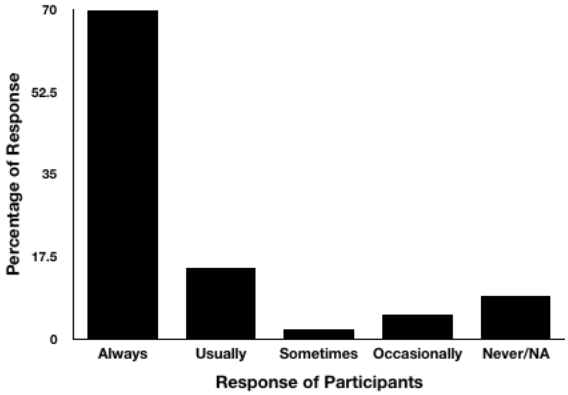
4.8 Work practices

Routine work practices of employees define the health and safety culture at any given place of work. Hence, two key questions were included in the pre-training questionnaire to test the work practices of the employees. One of the key questions was to find out how often do the employees "use guardrails instead of a fall arrest system". About 35% of the respondents replied that they "never" use guardrails or it does not apply to their work (Figure 13). It is interesting to know that around ~12% "always" use a very safe practice of using guardrails instead of fall arrest system (Figure 13). Another 15% use guardrails "usually" while 28% use guardrails "sometimes" (Figure 13). Another question was asked to know how often the workers practice a reasonable work practice of wearing seatbelts to work and on work site. The results show that close to 70% "always" use seatbelts, while 9% mentioned that they "never" use seat belts (Figure 13).

In the post-training questionnaire, work practices were extensively tested with 7 questions. The survey results show, ~80% of the workers have "never" used expired equipment, or "always or usually" used the ladder properly and "never" taken shortcuts to save time (Figure 14). Differences were observed in response to the question relating to the proper use of a ladder. While 16% of 6 Months group responded that they "Never or Occasionally" used three point contact for the ladder, significantly less number of respondents in 12 Months (8%) and 24 Months (5%) responded that they would "Never or Occasionally" use three point contact suggesting that less number of respondents in 12 Months and 24 Months are following unsafe ladder usage practice. The response to the question of how often the employees "discussed any concerns about height safety equipment with your supervisor/manager" is evenly distributed. While 15-25% of the employees mentioned that they "Always or Usually" discuss



At present, how often do you use guardrails instead of a fall arrest system?



At present, how often do you use seat belts when travelling to, from or around worksites?

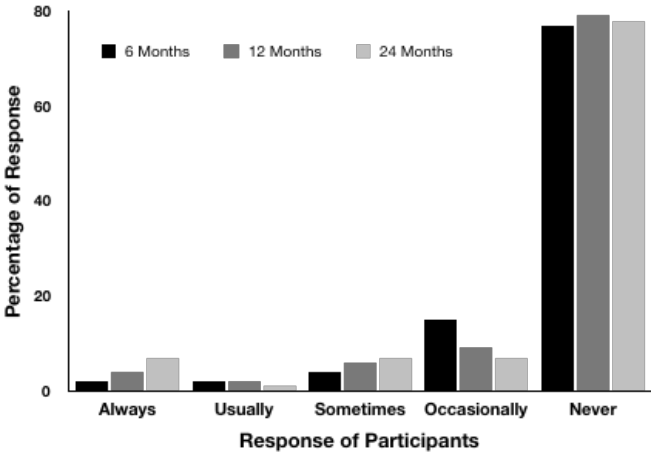
Figure 13: Pre-training Work Practices survey

Percentage breakdown of responses by the pre-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

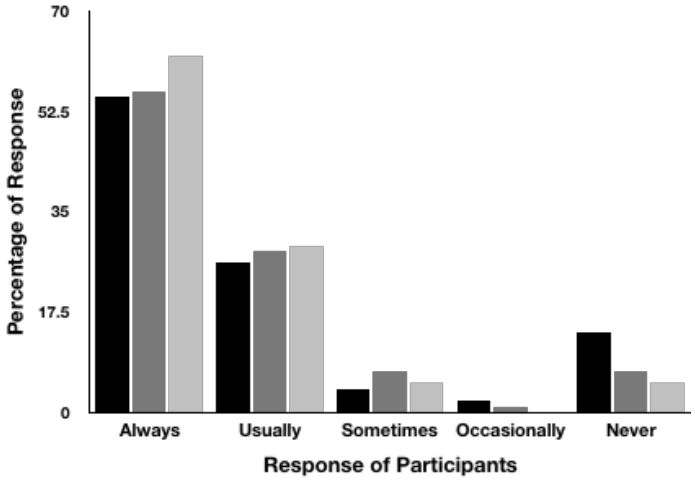
with their manager, about 20% employees mentioned that they "occasionally or sometimes" discuss with their manager. However, it is interesting to note that there are differences in the response among the three groups; significantly higher number of 6 Months group (24%) replied that they "never" discussed height safety equipment with their manager when compared to 12 Months (10%) or 24 Months group (16%) (Figure 15). Around 30% of the employees surveyed, responded that they "always" shared their safety concern with colleagues. However, differences were noted among the three groups; while in the 6 Months group 40% employees responded that they "Occasionally or Never" discussed safety concerns with colleagues, significantly less respondents in 12 Months (25%) and 24 Months (29%) mentioned that they "Occasionally or Never" discussed safety equipment with colleagues (Figure 15). In addition, an interesting pattern of response was observed when the participants were asked how often they used guardrails instead of fall arrest system. While in 6 Months group, ~46% responded that they "Never " used guardrail system, ~26% of the respondents from 12 Months and 32% of the respondents from 24 Months group mentioned that they "Never" used guardrails system. Furthermore, 24-34% of the respondents of all the three groups mentioned that they "Always or Usually" use guardrail system. On the whole, these results confirm that the workers in the post-training groups responded in higher numbers that they use good work practices further confirming that working at heights training course is effective in improving the work practices of the workers.

4.9 Risk and Accident Reduction

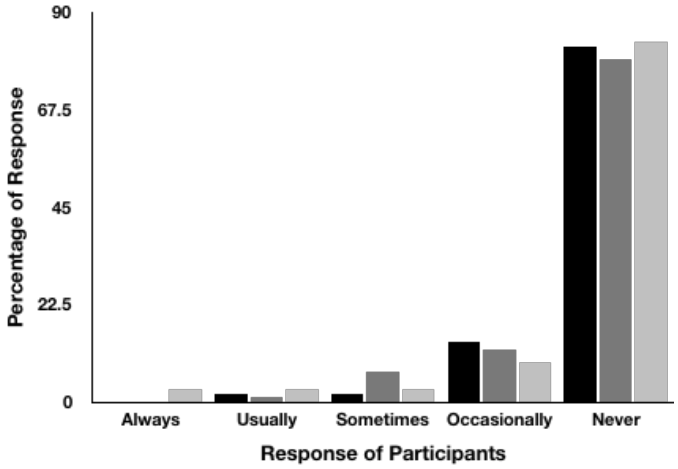
Good work practices and reduced risky behaviour on part of the employees will lead to safe working environment and reduced accidents. Hence, questions were included in the post-training questionnaire to determine if training leads to reduced risky behaviour. The survey results indicate that 85-90% of the respondents agree (strongly agree or agree) that they " do not take even small risks that can lead to accidents", or "do not perform jobs for which they do



Since your training, how often have you used height safety protection equipment that has expired?



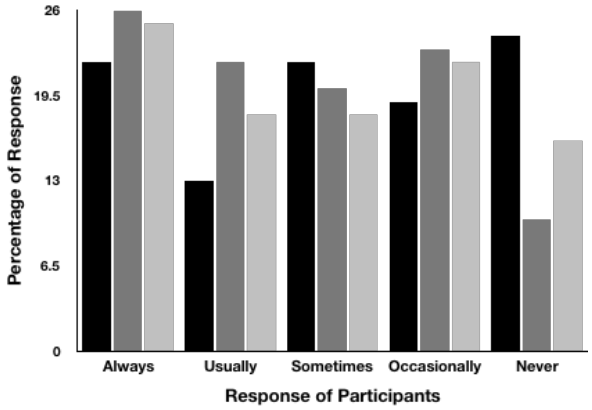
Since your training, how often have you maintained three-point contact when using a ladder?



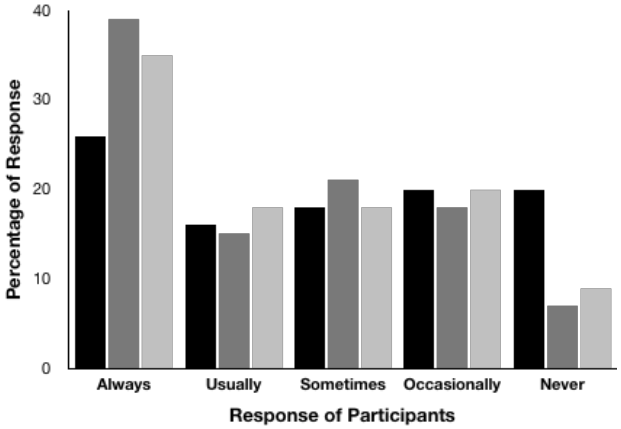
Since your training, how often have you been taking shortcuts to save time, even though there was a chance of falling?

Figure 14: Post-training Work Practices survey

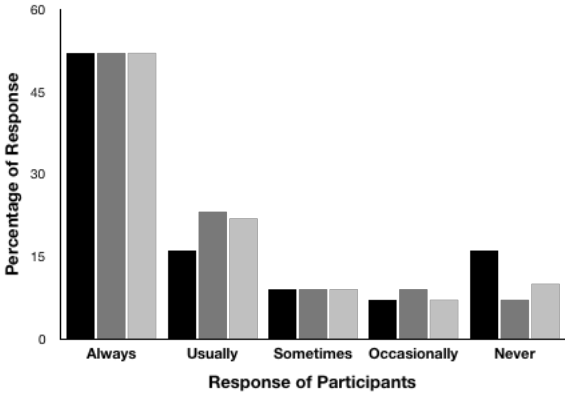
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



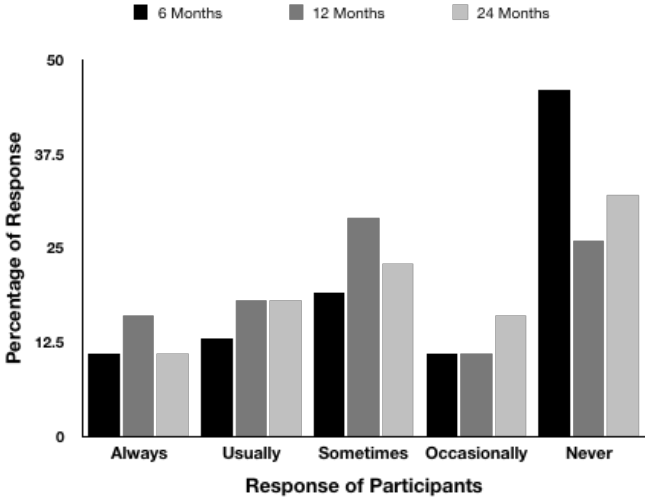
Since your training, how often have you discussed any concerns about height safety equipment with your supervisor/manager?



Since your training, how often have you raised any safety concerns about height safety with your co-workers?



Since your training, how often were you aware of the fall rescue plan before starting the job?



Since your training, how often did you use guardrails instead of a fall arrest system?

Figure 15: Post-training Work Practices survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants are shown on the X-axis.

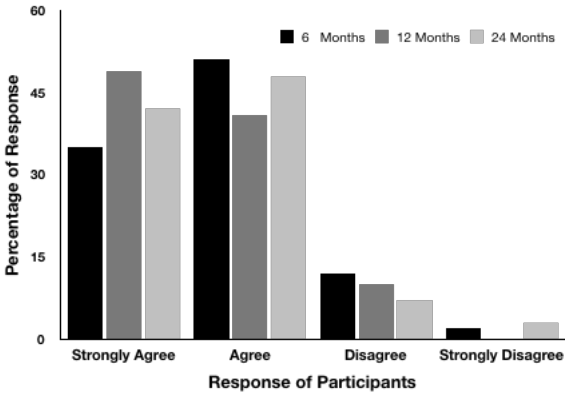
not have required knowledge/training" or "do not work without PPE" (Figure 16). Similarly a high number (85-90%) of the respondents mentioned that they agree (strongly agree or agree) that, as a result of the training, they would never work without safety equipment and that their work practices are much safer after the training (Figure 17). Collectively the survey results point out that training is effective in making employees aware of the risks involved in working without PPE or proper training. In addition, it appears that the training is effective in teaching good safe work practices and thereby reducing work related accidents. No major difference in the level of Risk and Accident reduction was seen among the three post-training groups (6 Months, 12 Months and 24 Months).

4.10 Hindrance Factors

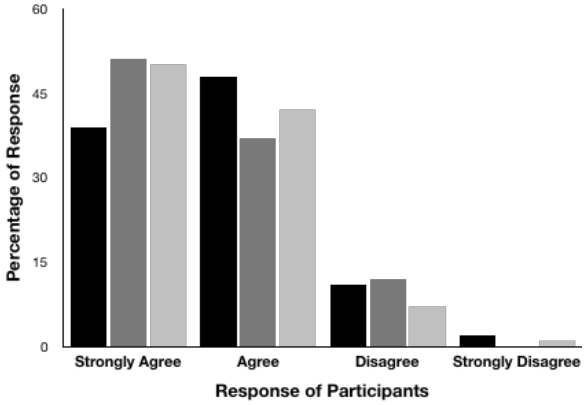
Hindrance factors are defined as those that pose hindrance for the implementation of the safety regulations. In the post-training questionnaire, 12 questions were included to test if the training helps workers to overcome several different types of hindrance factors to successfully implement the health and safety regulations. In response to two resource hindrance factors, about 70-80% of the respondents disagreed (strongly disagree or disagree) that equipment was not available, meaning that there were sufficient resources for successful purchase and use of safety equipment. However, close to 20-30% of the employees agree (strongly agree or agree) that there were not sufficient resources available for either purchase or replacement of the safety equipment (Figure 18). The results indicate that one fourth of the employees surveyed agreed that they were under resourced for the purchase/replacement of the safety equipment.

4.10.1 Personal Hindrance Factors

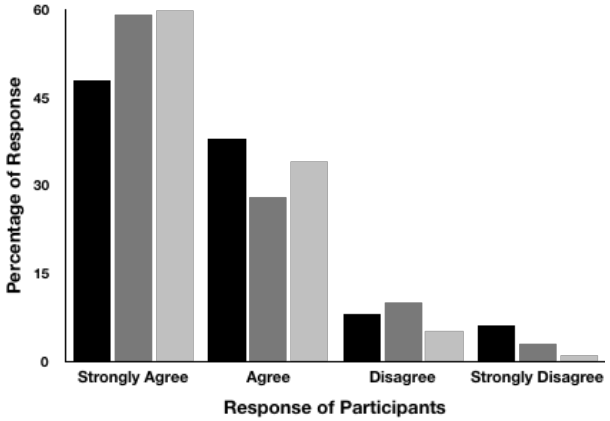
Five different personal hindrance factors were tested in the post-training questionnaire. The results show that 85-90% of the respondents disagreed (strongly disagree or disagree) and there by rejected the notions that (i) training material is too much to remember (ii) safety equipment is uncomfortable to wear (iii) safety training does not help (Figure 19). The other two



Since training, I do not take even small risks that can lead to accidents.



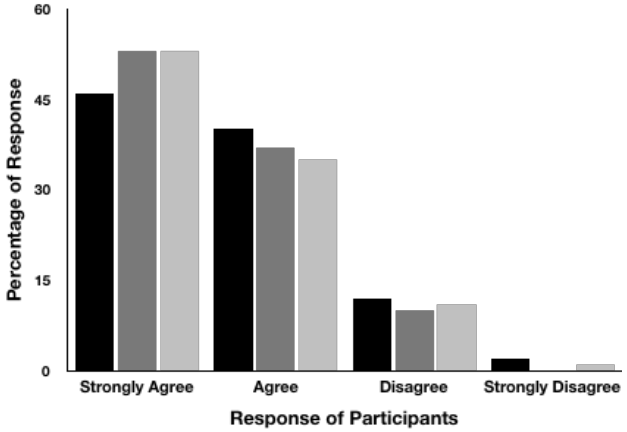
Since training, I do not perform jobs for which I do not have required knowledge/training.



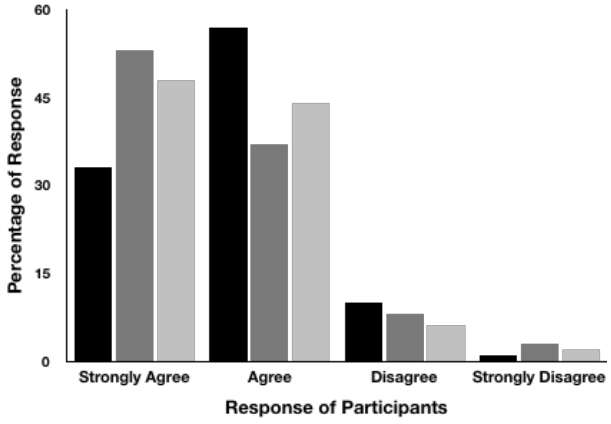
Since training, I do not work without PPE.

Figure 16: Post-training Risk and Accident Reduction survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



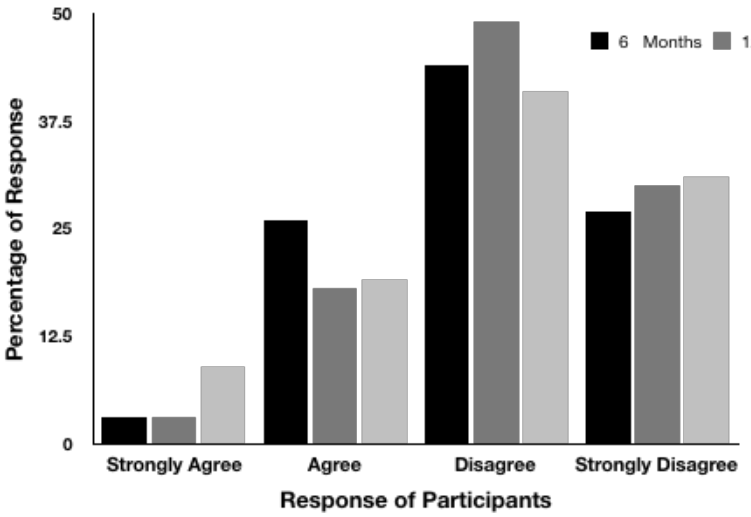
Since training, I never work without all necessary protection.



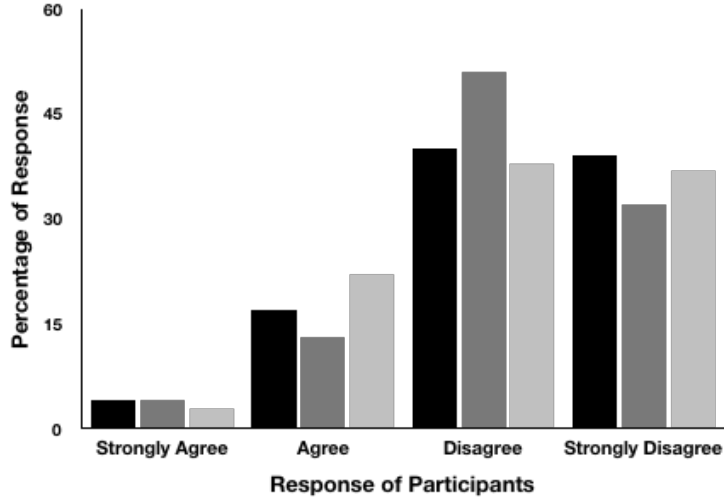
Since training, my work practices are much safer now.

Figure 17: Post-training Risk and Accident Reduction survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



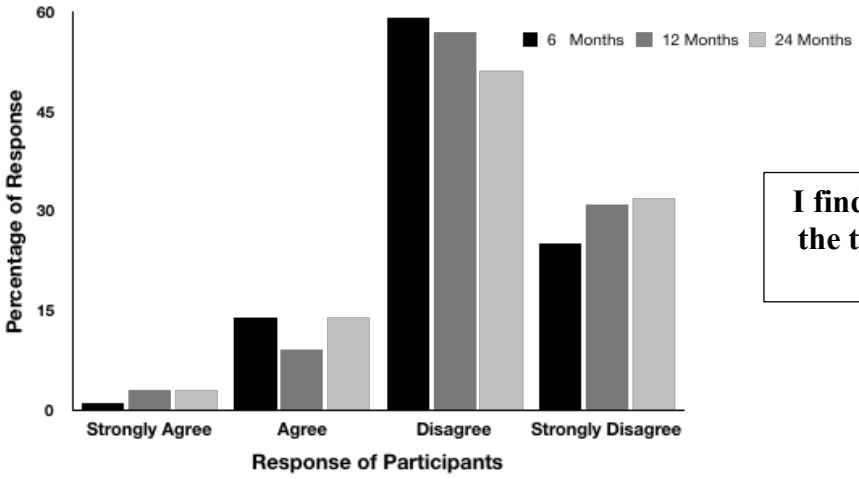
I find it hard to apply what I learned in the 'working at heights' training, because the equipment is not available at work.



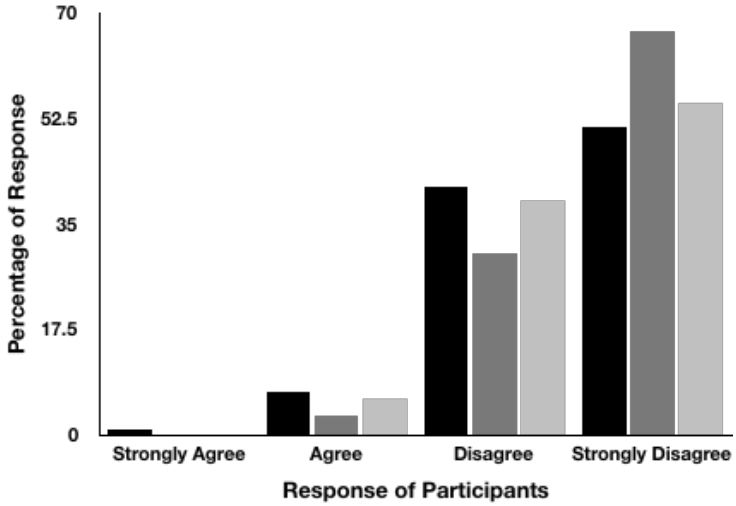
I can't always replace my height safety equipment when I should, because it is expensive and not readily available at work.

Figure 18: Post-training Hindrance Factors survey

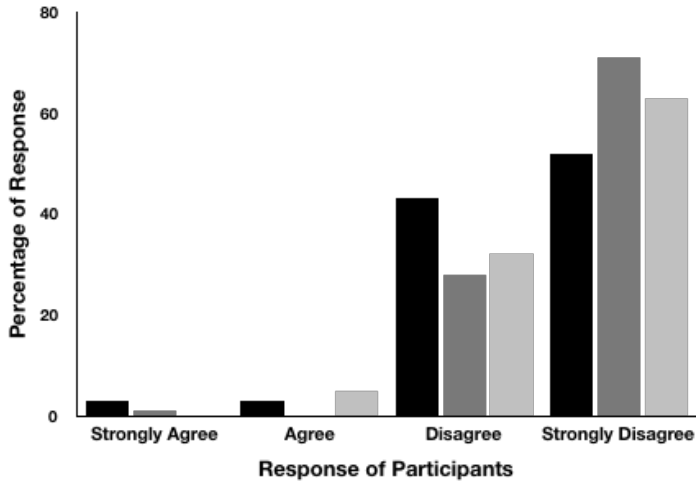
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



I find it hard to apply what I learned in the training, because there is too much to remember.



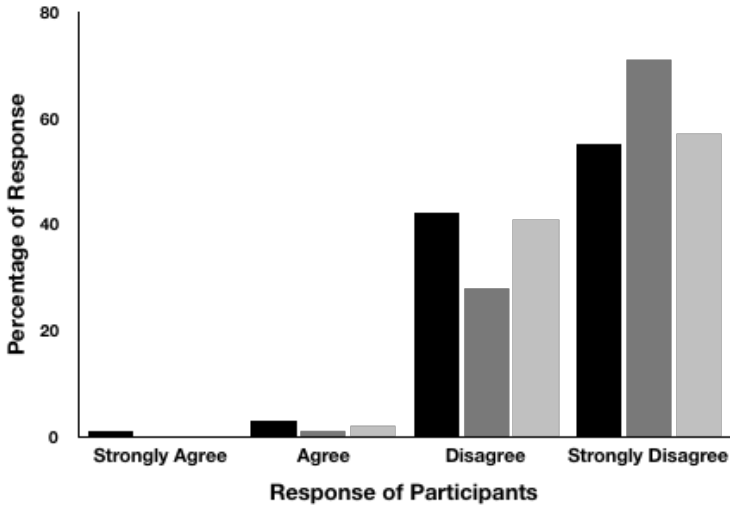
I don't wear the fall arrest harness when I should, because it is uncomfortable.



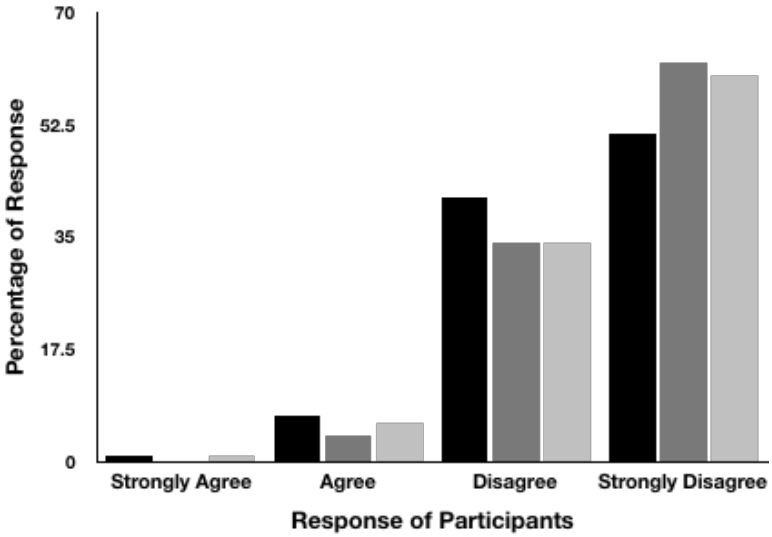
I don't follow what I learned in the training, because working at heights is a risky business any way and no amount of training is going to reduce the risk.

Figure 19: Post-training Personal Hindrance Factors survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



I don't follow what I learned in the training, because accidents hardly ever happen.



I don't follow what I learned in the training, because the training is conducted only to satisfy 'Worksafe'.

Figure 20: Post-training Personal Hindrance Factors survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

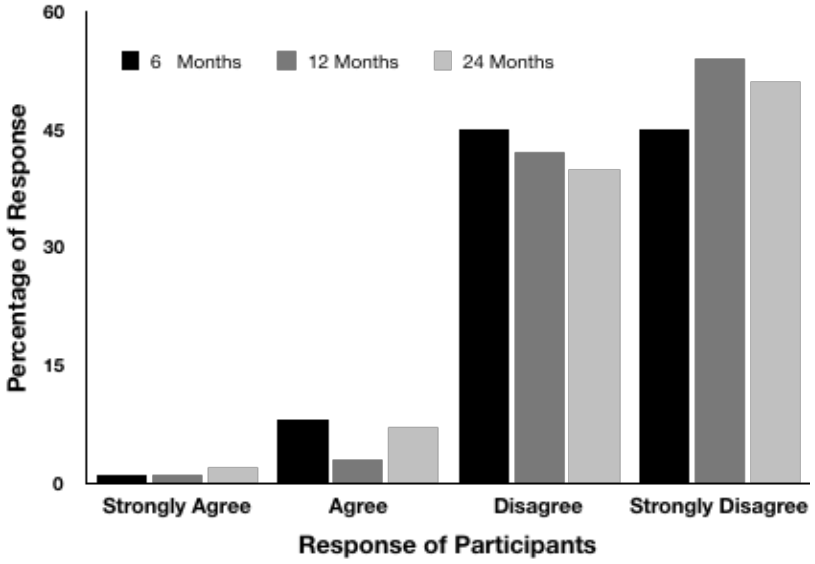
questions tested the personal beliefs as a hindrance factor. Ninety percent of the respondents rejected the misconception that accidents hardly ever happen and that undergoing training is only to comply with WorkSafe (Figure 20). Therefore, the survey results suggest that the training is effective in making employees overcome personal hindrance factors and there by implement the safety regulations at place of work.

4.10.2 Time Hindrance

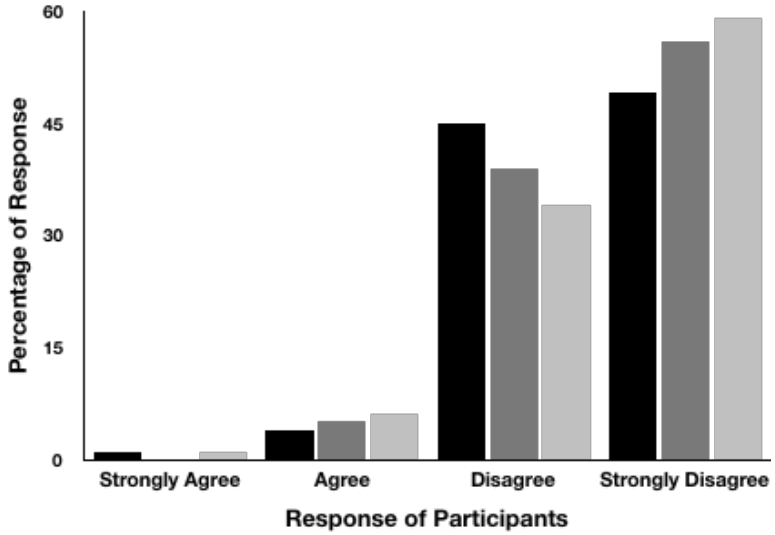
Compliance with safety protocols does consume time and some of the employees ignore safety practices due to time pressure. Hence, two questions were included in the post-training survey to evaluate how the training helps to overcome time hindrance. A large number of participants (90%) rejected (disagree or strongly disagree) the idea that (i) they do not have time to inspect the protection equipment before using it (ii) they do not use safety equipment because it slows them (Figure 21). The results point out that the training is effective in making the employees realize that time hindrance cannot be used as an excuse for not following the safety regulations. Therefore, it is obvious that the training is effective in imparting the safety knowledge to the employees.

4.10.3 Work place environment hindrance

The work place environment hindrance is very obstructive for implementation of the safety as the environment is not conducive for the health and safety. Hence, in the post-training questionnaire, three questions were included to test the co-workers, supervisors attitude and the work environment influences. More than 90% rejected (strongly disagree and disagree) all three notions that they do not follow (i) “fall prevention procedures learned in the 'working at heights' training because other co-workers do not follow fall prevention procedures” (ii) “don't follow fall prevention procedures learned in the 'working at heights' training because of my supervisor's relaxed attitude” and (iii) “don't follow fall prevention procedures learned in the



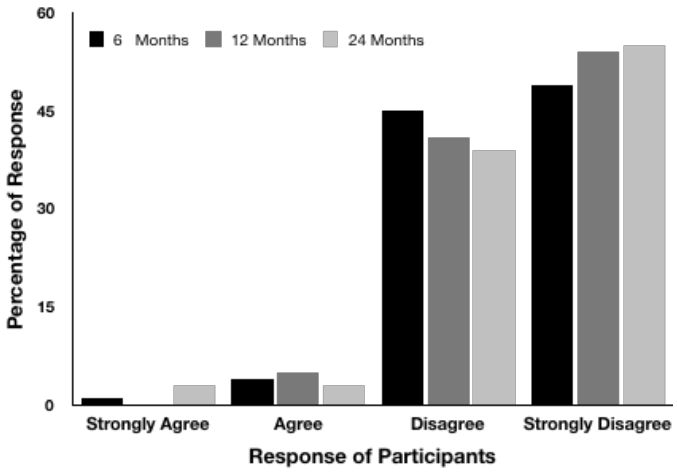
I find it hard to apply what I learned in the 'working at heights' training, because I don't have the time to inspect my fall protection equipment before using it.



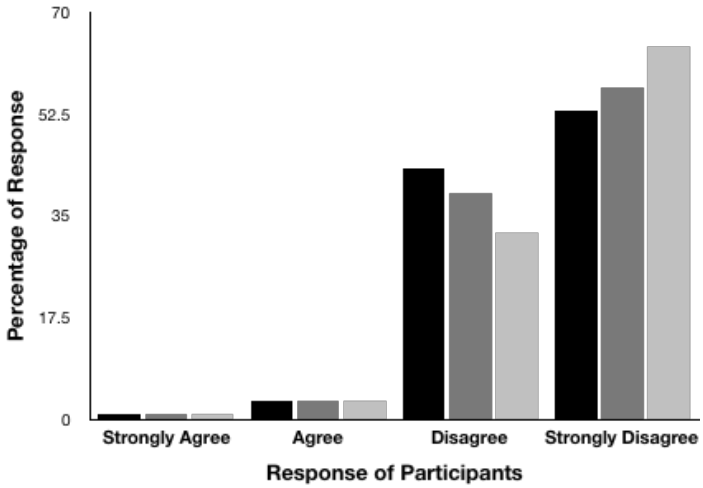
I don't use height safety equipment when I should, because it slows down my work.

Figure 21 : Post-training Time Hindrance Factor survey

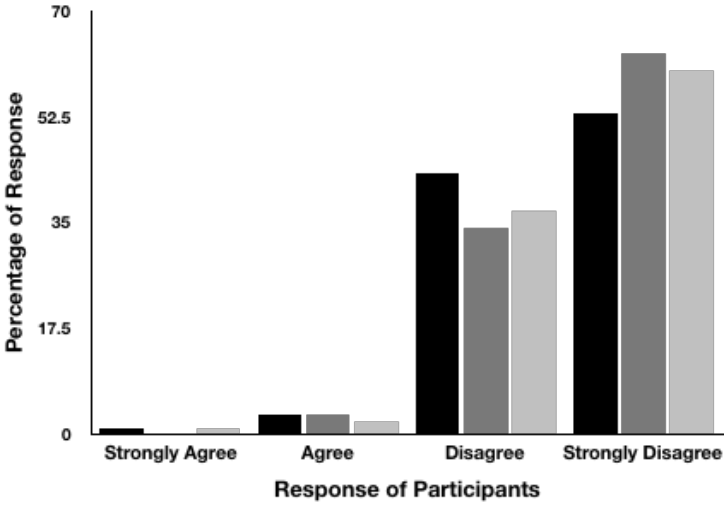
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



I don't follow fall prevention procedures learned in the 'working at heights' training because other co-workers do not follow fall prevention procedures.



I don't follow fall prevention procedures learned in the 'working at heights' training because of my supervisor's relaxed attitude.



I don't follow fall prevention procedures learned in the 'working at heights' training because there are no clear rules around fall prevention at my place of work.

Figure 22: Post-training Work Place Hindrance Factors survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

'working at heights' training because there are no clear rules around fall prevention at my place of work" (Figure 22). These results confirm that the training is very effective in teaching individual responsibilities and thereby overcome any work place hindrance for implementing the safety regulations.

Over all, no major differences were seen in the responses to hindrance factor questions among the three post-training groups (6 Months, 12 Months and 24 Months).

4.11 Facilitators

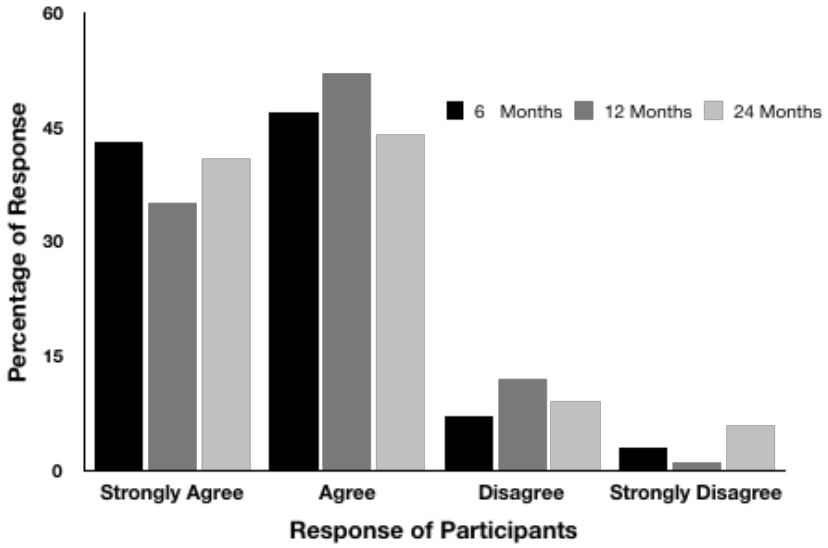
Facilitating factors allow smooth implementation of the safety regulations at work. Fourteen questions were included in the post-training questionnaire, to evaluate how different facilitating factors are influenced by working at heights training.

4.11.1 Resource Factors

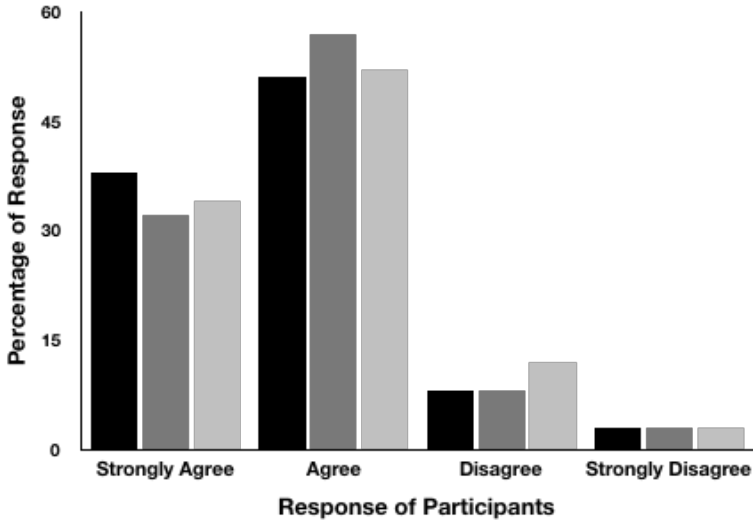
Eighty five to ninety percent respondents concur (agree and strongly agree) that (i) adequate resources were allocated for the purchase of safety equipment and (ii) that periodic audits are done to promote safety culture at work. However, 10-15% of the employees disagreed with both the questions indicating that there were not sufficient resources and that the periodic audits were not conducted (Figure 23).

4.11.2 Management Factors

Managers and management play a critical role in implementing the safety regulations. To evaluate how effective the training was on influencing the managers for implementing the safety regulations, 3 questions were included in the post-training questionnaire. A large number of the respondents (90%) agree (strongly agree or agree) that (i) "management strictly enforces height safety regulations", (ii) "management promotes high level of support for safety and fall prevention" and finally "management supports self-reporting of accidents and near misses" (Figure 24). This kind of support by the management would invariably lead to systematic enforcement of the safety regulations in a company. Therefore, the training is



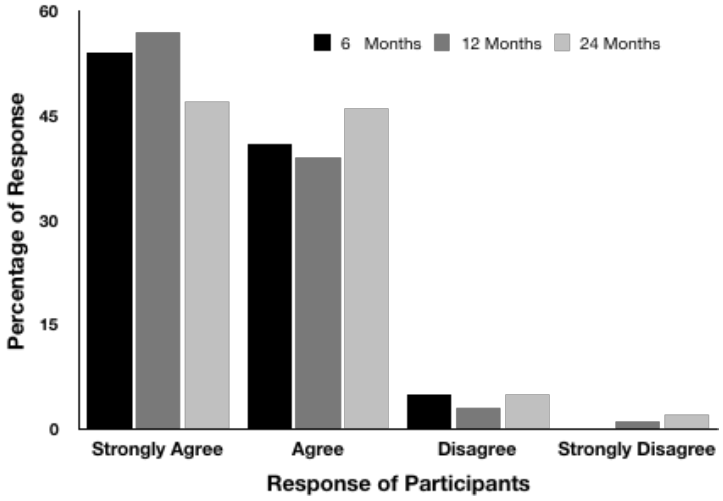
Adequate money is available to purchase and use safety equipment at my work.



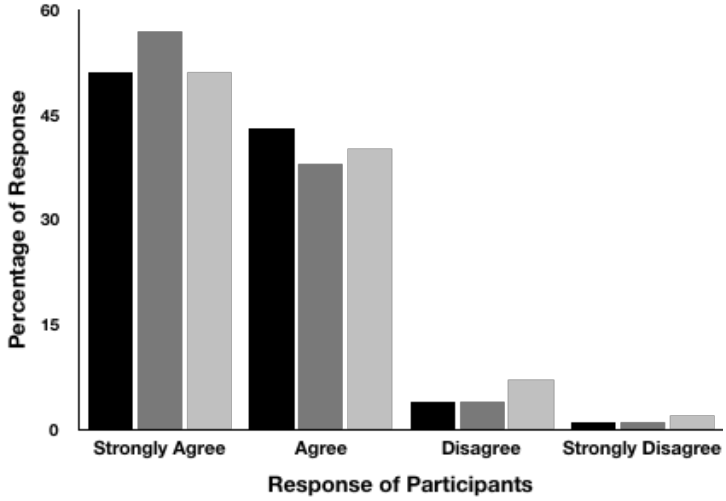
Periodical audits are conducted to promote safe working at

Figure 23 Post-training Resource Factors survey

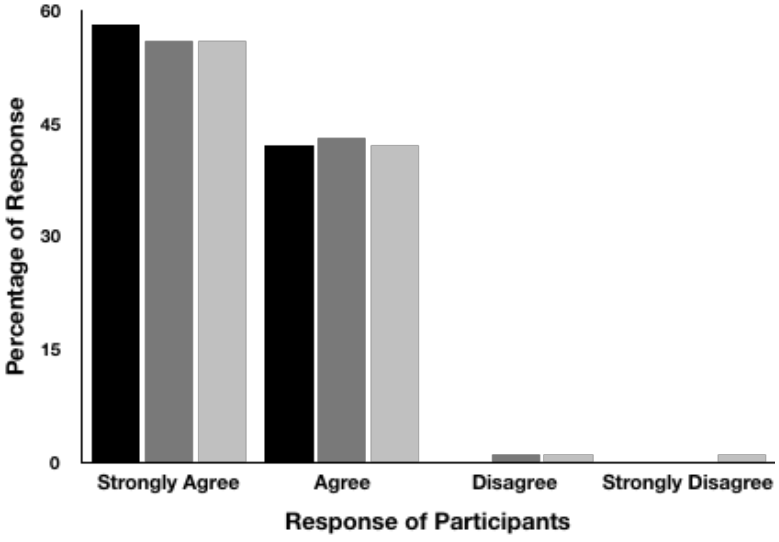
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



Our management strictly enforces height safety regulations.



Our management promotes high level of support for safety and fall prevention.



Our management supports self-reporting of accidents and near misses.

Figure 24: Post-training Management Factors survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

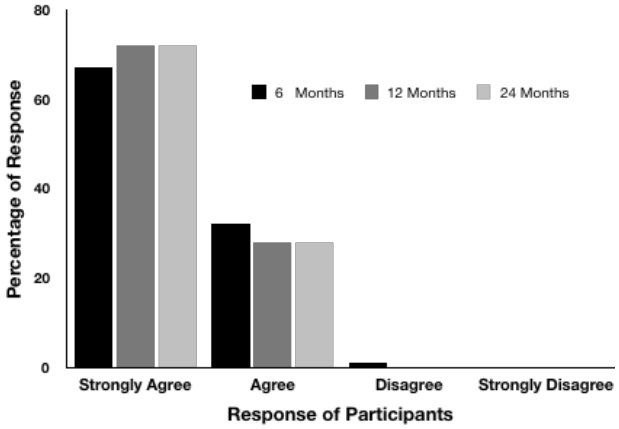
effective in making managers understand the importance of health and safety and also in influencing managers to allocate sufficient resources for successful implementation of the safety regulations.

4.11.3 Personal factors

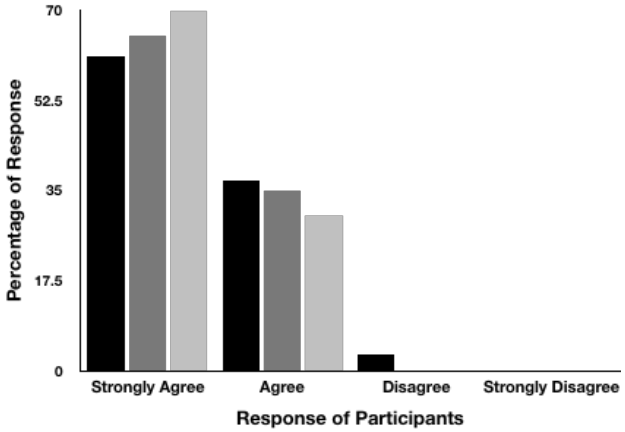
Personal factors are generally beliefs and attitude towards safety. Therefore, a wide variety of questions were included to test how the training influenced personal factors. The results indicate that over ~95% respondents agree (strongly agree or agree) that they are aware that they (i) "need to follow height safety rules when working at heights" (ii) also they "should always follow safety rules around fall prevention even when it takes longer to do the job" (iii) believe "in having a safety culture" (Figure 25). Similar to the previous question 90% of the respondents also agree (strongly agree or agree) that they will "raise awareness of safety and fall prevention rules with my colleagues" and "supervisors". Similarly, large majority (90%) agree (strongly agree or agree) that if everyone at work follows safety culture, there will be less accidents. Finally, the large majority also agreed (strongly agree or agree) that reporting accidents/incidents improves the safety record (Figure 26). Collectively, these results clearly indicate that the training is very effective in reinforcing the safety culture in employees.

4.11.4 Relationship Factors

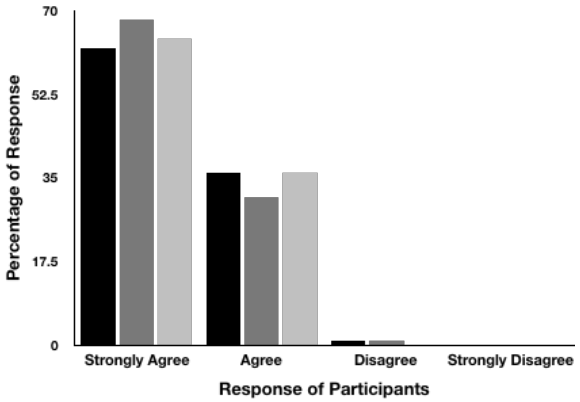
Healthy positive interactions among co-workers are essential for a good safety environment at work place. Hence, two questions with regards to relationship among co-workers were included in the post-training questionnaire. A large majority of the workers (90%) agreed (strongly agreed or agreed) that co-workers (i) "encourage each other to follow safety and fall prevention protocols" and that (ii) employees "are not ridiculed if they follow safety and fall prevention protocols". Therefore, the training is effective in teaching value of team work in maintaining the safety culture at work (Figure 27).



I am aware that I need to follow height safety rules when I am working at heights.



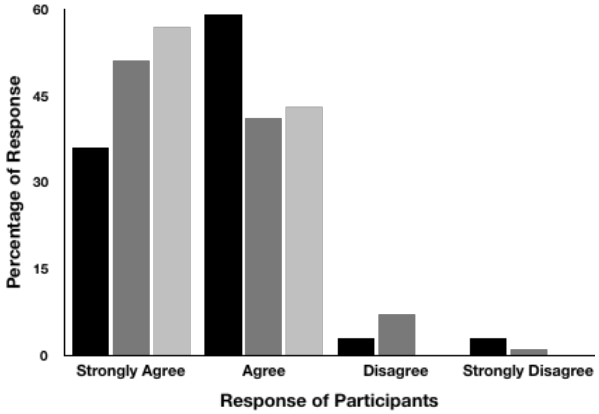
I should always follow safety rules around fall prevention even when it takes longer to do the job.



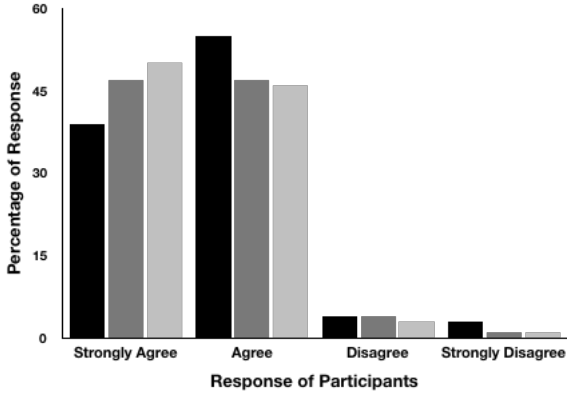
I believe in having a safety culture and this helps in height safety.

Figure 25: Post-training Personal Factors survey

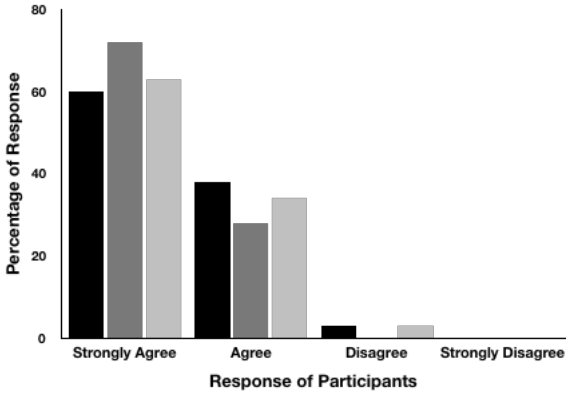
Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



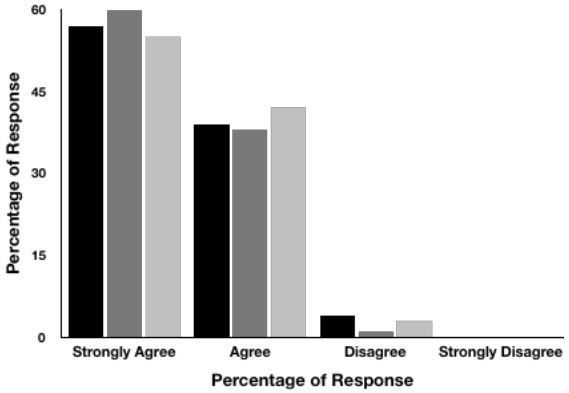
I raise awareness of safety and fall prevention rules with my colleagues.



I raise awareness of safety and fall prevention rules with my supervisors



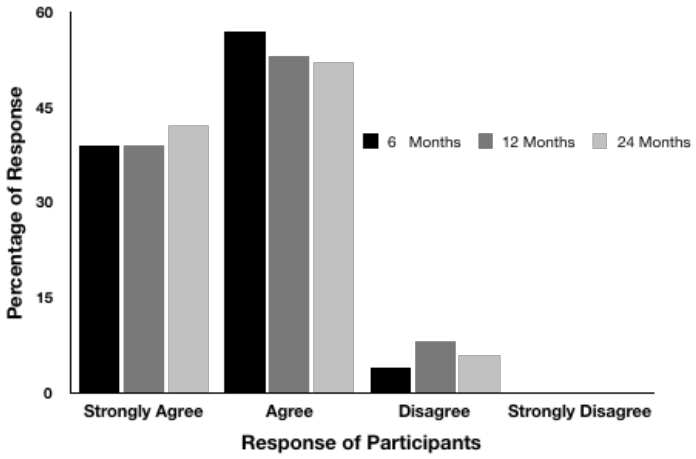
I believe that if every employee follows height safety procedures, it will reduce accidents



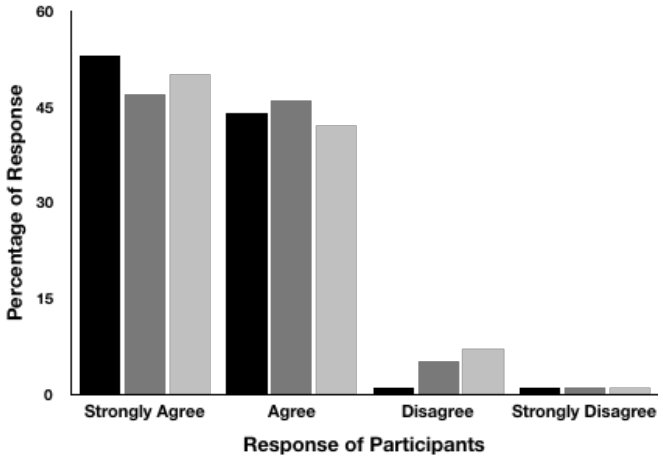
In my opinion reporting accidents/incidents and near misses help us to improve safety.

Figure 26: Post-training Personal Factors survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.



Co-workers encourage each other to follow safety and fall prevention protocols at my company.



Employees at my company are not ridiculed if they follow safety and fall prevention protocols

Figure 27: Post-training Relationship Factors survey

Percentage breakdown of responses by the post-training survey participants is shown in the bar graph. The respective questions are shown in the text box next to the bar graph. Percentage of response is shown on Y-axis and response of the participants is shown on the X-axis.

Over all, no major differences were seen in the responses to facilitator questions among the three post-training groups (6 Months, 12 Months and 24 Months).

5 Chapter Five: Discussion

Implementation of the health and safety regulations to create a safe working environment is paramount at work place in New Zealand. The research has clearly pointed out that there are far too many accidents in the construction industry that involve working at heights despite new health and safety legislation and enforcement penalties. Working at heights safety training is an important contributor towards educating an employee and creating a safe working environment. Therefore, lack of proper training or ineffective training of employees could potentially lead to unsafe working environment and accidents in the construction industry. Hence, in this thesis the effectiveness of "working at heights" training program has been evaluated.

The training effectiveness was evaluated by conducting the pre and post-training surveys. The percentage of completion of the survey was very high (100%) for the pre-training survey since the trainees were on the site and had more positive attitude towards participating in the research. In contrast, the internet based survey of the post-training employees had relatively poor response of around 10%. This type of poor response is not uncommon as many studies have repeatedly shown a response of 10-30% . There could be many reasons for this type of poor response (i) pre-occupation with the job (ii) general lack of interest to participate in research (iii) lack of financial incentives to complete the survey and (iv) lack of trust even though complete anonymity is promised.

Demographic analysis pointed out that the majority (~90%) of the pre and post-training employees were male. Since, the working at heights involved construction sector as the major employer, it is no surprise that majority of the participants were male. Another interesting demographic is the age group. In the pre-training survey, maximum number of the trainees involved belong to younger age group of 25-34 years as opposed to the post-training respondents, where there is a shift towards older age groups of 35-44 or 45-54 years.

This shift in age group could be due to the fact that post-training employees have been in an employment for many years.

5.1 Working at heights training effectiveness in improving safety knowledge

It has been shown that, having an integral safety knowledge in an organization is critical for a successful implementation of the health and safety regulations at work. Therefore, it is essential that workers have knowledge of not only all the hazards at work place, but also the knowledge of proper use of equipment. Hence, both the pre and post-training questionnaires were designed to contain the safety knowledge questions to find out if the training was effective in acquiring the safety knowledge (Figure 1-3). Several comparisons between the pre and the post-training surveys establish that the training was indeed effective in improving the safety knowledge. Only 50% of the pre-training cohort agreed that they "always" maintained the 3-point contact for the ladder (Figure 1-3). However the post-training survey results show that close to 90% employees agreed or strongly agreed that they maintained the 3-point contact of the ladder (Figure 1-3). A further comparison of the mean values of all the safety knowledge responses (between the pre and the post-training surveys) revealed that the training indeed is effective in improving the safety knowledge. While only 68% of the pre-trained workers agreed that they "always' or "usually" follow the safety protocols a higher number, ~92% , of the post-training surveyed workers agreed that the training helped them improve their knowledge. Ladder usage is fundamental to the working at heights as WorkSafe research points out that 70% of falls are from ladders and roofs underscoring the importance of the proper use of ladders in reducing accidents. In addition to the ladder usage, the post-training survey used four technical aspects of working at heights that included attaching height safety system, identifying suitable anchor points, proper safety practices and tying appropriate knots to evaluate the safety knowledge. Vast majority of the employees (85-90%) confirmed that training did improve their knowledge

in the technical aspects of working at heights. These results clearly establish that the majority of the participants agreed that working at heights course (offered by VHNZ) was successful in imparting, technical and theoretical knowledge about working at heights (Figure 2 and Figure 3). The study also shows that, once the safety knowledge is acquired, it is retained for at least 24 months as there was no observable difference in the acquired safety knowledge among 6 Months, 12 Months or 24 Months post-training groups (Figure 1-3). There are several possible reasons for this prolonged knowledge retention. Firstly, as the technical knowledge is frequently used in the line of work, it is possible that workers retain the knowledge. Another reason could be the "refresher training" that most of the workers undergo at Vertical Horizonz that could keep the employees up to date with the safety knowledge and legislation. Some of the previous studies that evaluated the training effectiveness also showed similar results of the improved safety knowledge of the workers after the training. Robson and Mustard (Mustard, 2019) reported that heights training resulted in a significant increase in the safety knowledge acquisition by the employees. Importantly this knowledge was perceived as the most useful by the employees. In addition, Taylor (Taylor, 2015) also showed that the training improves the safety knowledge in the construction workers. Therefore, it is clear that the training is effective in improving the safety knowledge among the employees.

5.2 Working at heights training effectiveness in improving safety behaviour

Safety culture is driven not only by the attitude and perceptions of workers towards the safety but it is also influenced by the safety behaviour of the employees. As a matter of fact the safety behaviour is considered as the most important aspect of the safety culture as some of the studies have shown that lack of the safety behaviour is directly linked to increased accidents at work place (Dodoo & Al-Samarraie, 2019). Therefore, current research used questions related to the safety compliance and the safety participation to test the

effectiveness of the training on improving the safety behaviour among the employees. The survey result comparison between the pre and the post-training groups revealed a significant improvement in the safety behaviour as a result of working at heights training (Figure 4-6). When the mean of the responses to all the safety behaviour questions were calculated, only ~53% of the pre-training workers mentioned that they "always" or "usually" had adapted the safety behaviour. In contrast a significantly higher number of the post-training workers (~82%) "agreed" or "strongly agreed" that the training had helped them to improve their safety behaviour. A ~55% improvement in the positive response after the training to safety behaviour questions clearly demonstrates that the VHNZ designed working at heights training is effective in improving the safety behaviour of the employees. The current results also demonstrate that the training has significantly improved the safety participation by the employees such as obtaining fall rescue plan and wearing an industrial grade helmet (Figure 4-6). The comparisons of responses by the post-training group revealed in response to the question "I will change the way I take safety precautions" a higher number of the respondents of 13% in the 12 Months and 24 Months groups "disagreed" with this statement as compared to 5% in 6 Months group. The response essentially means that a higher number of the workers in the 12 Months and 24 Months groups do not change the way they take the safety precautions even after the training. Given that these two groups have more working experience than 6 Months group, it is understandable that the workers in this group do not want to change their well-established safety practices. Overall, this part of the survey confirmed that the training is effective not only in imparting the safety knowledge, but also effective in improving the safety behaviour. Having a good safety culture/climate (due to enhanced safety participation and behaviour) can lead to reduced injuries (both minor and major) and increased productivity. Not surprisingly some previous studies have also confirmed that the training is effective in improving the safety behaviour. A previous study

in Canada showed that the training improves significantly the employee behaviour (Mustard, 2019). In an independent study on the residential construction workers, the results showed that fall prevention education program improved the self-reported work site behaviour of the employees (Evanoff et al., 2016). Therefore, it can be concluded that the training is effective in improving the safety behaviour of the employees.

5.3 Working at heights training effectiveness in improving confidence and awareness

Safety awareness in the employees is derived from the thorough understanding of the safety legislation. This in turn will lead to increased confidence in the employees which will also enable them to stop colleagues from performing unsafe work practices. Therefore, the employees with good safety awareness at work would contribute to good safety environment. Hence, improvement in the safety awareness and confidence was tested in the pre and the post-training groups to determine the effectiveness of the training. A number of safety awareness measures were included in the questionnaires to gauge the impact of training on the safety awareness and confidence of the workers. While in the pre-training group 40% of the respondents answered that they would "always" raise safety concerns in a meeting with supervisor and with their colleagues , 90% of the post-training cohort agreed that they would raise safety concerns, if they see any, with their supervisors and stop colleagues from unsafe work practices (Figure 7). Therefore, as a results of the training, there is a 125% increase in awareness and confidence of the employees (Figure 7-9). In addition, the mean values of the responses to the confidence and awareness questions were compared for both the pre and the post-training surveys. The results show that the training improved the safety awareness response by 33% (68% pre-training Vs 92% post-training) further confirming the effectiveness of the training. Collectively, the results point out that the training is effective in improving the awareness of the safety regulations and improving worker's confidence. Another significant observation in this study is that, there is no overall

decline in the safety awareness even after two years after the training. Such a long lasting effectiveness of the training in improving the awareness and confidence could be attributed to the training course content, hands on training or illustrations that were used in the VHNZ training course. In addition to the training, there needs to be a constant reminder at work for continued promotion of the safety awareness. This can be accomplished by frequent "refresher" courses. Other promotional media such as periodic emails, social media and/or newsletter reminders are known to improve the safety awareness at work. Holding "safety themed" weeks and putting up the safety bulletin boards are also proven to improve the safety awareness. For all these communications to work as a constant reminder, the management support along with resources are required. Therefore, good management facilitator factors are critical along with the training for successful safety awareness and safety climate at work. These results are further supported by Ricci et al (Ricci, Chiesi, Bisio, Panari, & Pelosi, 2016) who observed that, in the literature there is a strong support for the effectiveness of the training in improving the safety attitude, awareness and commitment in the workers.

5.4 Working at heights training effectiveness in improving safety commitment

Safety commitment is generally associated with an organization and the management. However, research has shown that a commitment to the safety and thereby improving the safety performance in an organization, starts at individual employee level. Thus, an employee's safety commitment can influence the safety outcomes not only for him/herself, but also for other co-workers in the company. Given the importance, the effectiveness of the training in improving the safety commitment was explored in this study. Eighty five to 90% of the post -training workers responded in the survey that the training has given them the confidence to (i) ask the manager a question on safety and not be embarrassed and (ii) stop a co-worker from practicing unsafe work practices (Figure 10). What is impressive is

that 85% of the post-training employees also agreed that they prioritise safety over getting the job done after attending the training (Figure 10). These results indicate that the training is very effective in teaching the safety commitment to the employees. One other point to note is that the length of the employment after the training is immaterial as the 24 Month group performed equally well as the 6 Month group in the safety commitment survey.

In general, the lack of commitment to the safety comes from lack of knowledge of the safety. Since the current study has shown that the VHNZ training is effective in not only imparting the safety knowledge but also in the knowledge transfer, it is likely that the training has a flow on effect on the safety commitment too. Inculcating the safety commitment would result in the employees who are more mindful of the safety regulations even when they are tired at the end of the shift, wear all the necessary PPE to complete a job and less likely to break rules to get a job done faster (Figure 10).

How to get employees to commit to safety on long term basis? The simple answer is that, the employees commit to something if it is beneficial to them. Therefore, both long term and short term benefits of the safety in reducing accidents and improving the health should be made clear to the employees. Secondly, it is essential to get employees involved at the grass root level and at the safety policy making and implementation stages. Furthermore, the commitment by management for strict enforcement is absolutely essential for the safety commitment by workers. An interesting discovery of this study is that , about 10-18% of the post-training employees mentioned that, getting the job done is more important than following the safety regulations and that they do not report unsafe practices even if they observe. This result establishes that albeit small, a significant portion of the workforce do not make commitment to the safety regulations despite the training. These results indicate that, the continued lapses in the safety and persistent accidents in the construction industry could be due to lack of commitment to the safety by a small population

of the workers. It is therefore, essential for management to address the workforce who lack commitment to the safety early on and reinforce the values of the safety at work continuously. Burke et al (Burke et al., 2006) in a previous publication showed that, as the training methods became more engaging, the workers demonstrated greater awareness of the safety regulations, and showed improved commitment to the safety which reduced accidents and injuries. Furthermore, Nkomo et.al confirmed that the training is effective in improving the safety awareness in the forestry contractors in KwaZulu-Natal (Nkomo, Niranjan, & Reddy, 2018).

5.5 Working at heights training effectiveness in reducing risk acceptance

Risk management is very critical when working at heights. For an efficient management of the risk, it is important to map all the risks and the hazards associated with a workplace followed by taking appropriate steps to manage or mitigate the risks. However, accepting the risks and inactivity invariably leads to tragic health and safety issues at work. Therefore, effectiveness of the training in reducing the risk acceptance was evaluated in this study. The results suggest that, because of the training, there is an increase from 76% (pre-training) to 87% (post-training) in the cohort that rejected the risky behaviour with a concomitant decrease from 14% (pre-training) to 5% (pre-training) in the cohort that "always" or "usually" displayed risky behaviour. These results confirm that the training is effective in reducing the risky behaviour of the employees and therefore improving the safety behaviour. Specifically, the training is effective in making the employees realize that they cannot perform jobs for which they are not trained, they should always wear all the necessary PPE and should not work without all the safety equipment even if they are told to increase the productivity. The analysis also showed that despite the training, there is a 10-15% population in the post-training cohort who are "risk accepting" population. Albeit a low number of employees were accepting risk, from the safety point of view, it should still be a

concern. Perhaps work pressure and lack of funding for the safety equipment could have resulted in such "risk accepting" behaviour in a minor population of the workers (Figure 11-12).

As opposed to "risk accepting", "risk and accident reduction" examines the ability of the workers to reject unsafe practices but adopt the safety procedures to reduce accidents. Analysis of the post-training "risk and accident reduction" data revealed that since the training 90% of the employees (i) refuse to take even small amount of risk, (ii) wear PPE all the time, and (iii) do not perform jobs for which they do not have proper training. The employees also confirmed that their work practices are much safer after the training. These results confirm that the training is effective in reducing the risky behaviour in the post-training employees. Therefore, it can be concluded that the training program of VHNZ makes the trainees aware of the hazards and the risks and reduces the risky behaviour of the employees there by creating a good safety culture (Figure 11-12).

5.6 Working at heights training effectiveness in improving work practices

The critical nature of routine "work practices" in determining worker's safety cannot be underestimated as they play an essential role in determining the safety climate at work place. Some of the examples of safe work practices at heights are wearing seat belts, using guardrails, not taking short cuts, using proper non-expired equipment and using the ladder properly. The routine work practices are generally written methods that are most frequently used and therefore they minimise the risk to people, equipment, materials, environment, and processes. Furthermore, safe work practices are also designed based on the identified hazards and therefore, performing them routinely without a fail, tremendously improve safety environment. Hence, it is essential that the training courses teach the importance of the work practices and thus improve the health and safety. In the pre-training survey there was a mixed response from the workers for two independent safe work practices. While

85% of the cohort agreed that they are choosing to wear seat belt to work, only 28% replied that they "always or usually" use guardrail, which is a safe practice. It is noteworthy that 44% of the pre-training cohort answered that they "never or occasionally" use guardrail. However, in the post-training groups, a consistency was observed in the answers to all the work practice questions. In response to all the work practice questions, 90% of the post-training cohort agree that (i) they did not use expired safety equipment, (ii) properly use ladder and (iii) never taken short cuts to save time. Therefore, the results prove that the training is effective in inculcating good work practices in the employees. In a study conducted by Mustard et.al., (Mustard, 2019), the authors reported a significant improvement in the work practices by the construction workers as a result of the training. Specifically, the workers reported that as a result of the training, they "often" inspected the fall equipment before use and maintained 100% tie-off suggesting that the training helped them to improve the work practices.

5.7 Working at heights training effectiveness in reducing hindrance factors

For successful implementation of the safety regulations, the workers not only need to have safety knowledge and attitude, they also require full support and commitment from the management. In addition, they would need resources and should not encounter hindrance factors such as personal, time and work place hindrance factors. The post-training survey results point out that around 25% of the employees agreed that they were under resourced to purchase or replace the appropriate safety equipment. Several reasons could be behind the lack of resources for the safety equipment. One possibility is that the management may lack safety knowledge or may not be committed to the safety in the company. Other possible reason could be that the company could be struggling financially and thus the funding safety equipment may not be their priority. Therefore, this survey highlights a safety issue that could possibly explain the significant number of accidents/injuries seen in the construction

industry. It is noteworthy that majority of the trainees in the working at heights training courses are workers but not managers. If the managers are equally encouraged to attend the working at heights training course, perhaps the training will be effective in emphasizing the importance of the safety and motivate them to allocate sufficient resources for the safety equipment.

The survey results also point out that the training is effective in reducing the hindrance factors for the implementation of the safety regulations. When the response average were calculated, the results revealed that ~94% of the post-training respondents disagreed that personal hindrance factors influenced their safety practices (Figure 19). This survey results show that the workers disagreed that there was too much to remember. Another possible personal hindrance factor encountered at work could be the discomfort faced by the employees while working with the safety equipment. However, the post training survey prodigiously (85%) supported the fact that the workers did not feel that the safety equipment is too heavy or uncomfortable. The results also suggest that the training was able to help the employees to overcome myths that accidents rarely happen and that safety training is conducted only to please WorkSafe (Figure 20). All these facts collectively prove that the working at height safety training conducted by VHNZ is very effective in imparting the safety knowledge without burdening the students with unnecessary information. This in turn helped the workers to overcome any personal hindrance factors for the implementation of the safety regulations.

Time hindrance is another factor that was tested in the survey. Ninety three percent of the post-training workers surveyed agreed that they did not take short cuts and checked the safety equipment before using it and that they did not feel that the safety equipment was slowing their work (Figure 21). These results suggest that the safety training was effective in highlighting the importance of the health and safety at work to the employees.

Furthermore, the training was effective in convincing the employees that they need to pre-check all the safety equipment and that the time invested does not reduce their productivity. In conclusion, the training is effective in overcoming the time hindrance factor.

Workplace environment is critical for implementation of the safety regulations. Relaxed attitude of the supervisors or ignoring the safety regulations by the co-workers are both considerable hindrance factors at work. This study results suggest that~95% of the VHNZ trained workers followed the safety regulations regardless of the safety attitude of the supervisors and the co-workers (Figure 22). One can infer that the training did inculcate the importance of following the safety regulations at work and creating good safety environment. Therefore, it can be concluded that the training is effective in not allowing the workplace hindrance factors adversely affect the work place safety. These results are in agreement with the previous publications indicating that support of the management, Human Resources and resource factors are essential for implementing the safety regulations at work (Ismail et al., 2012; Lingard & Holmes, 2001).

5.8 Working at heights training effectiveness in enhancing facilitator factors

In the current study, the "Facilitator factor" survey confirms that, ~90% of the employees confirm that the management was supportive of enforcing the health and safety regulations at work by allocating resources for implementation of the health and safety and purchase of the equipment (Figure 23). Furthermore, ~92% of the employees also concur that the management is also highly supportive and very strict in implementation of the health and safety. In addition, ~93% also agree that the management encourages self-reporting of the accidents (Figure 24). It is interesting that the level of support for the management is significantly better when the questions were framed in more positive way (Facilitator factors) (~92%) as compared to when the questions were framed in a negative connotation (75%) under "hindrance" factors.

When “personal factors” and “personal relationships among co-workers” were tested as facilitating factors, 90% respondents agreed that they were “aware” of the safety rules and that they “should” follow the safety rules and had a “belief” that having a safety culture would help in implementing the health and safety regulations at work and that if every employee follows health and safety regulations that would lead to reduced accidents (Figure 25-26). Furthermore, 89% of the respondents also agreed that they would “raise awareness” of the health and safety not only with colleagues but also with the supervisors (Figure 27). Collectively, an average 80-90% of the post-training respondents during the current study indicates to the effectiveness of the training in imparting the safety knowledge, culture, behaviour and attitude to the employees.

To the best of our knowledge, the current study is one of the first studies that analysed the effectiveness of the working at heights training provided by a commercial company. Another novel finding of the current study is that, VHNZ working at heights training positively influences facilitator factors and reduces hindrance factors confirming that management is committed to implementing safety at work in New Zealand.

5.9 Limitations of the study

Current study is one of the first attempts to understand the effectiveness of working at heights training provided by a commercial company (VHNZ) in New Zealand. In the current study, data collected from the pre-training cohort who have not undergone working at heights training, were compared with the data collected from the post-training cohort. One of the first problems encountered was the limited sample size for both the pre and the post-training cohorts. Although the survey requests were sent out to around 3500 post-training workers, the survey participation rate was very low (~10%). A longer time frame to finish the study would have allowed time for sending more reminders and thus better participation rate. Similarly for the pre-training survey, only 68 trainees were recruited due

to time constraints. As a result of the low numbers, an extensive statistical analysis was not possible to clearly document interactions among various safety climate factors. Another limitation faced due to lack of time was inability to do a longitudinal study. The current study compared the data generated from an independent pre-training and post training cohort but not from the same cohort in a longitudinal study. Longitudinal study allows large sample size and multiple samplings at different times during a year or two. This type of study would enable a robust statistical analysis which would further enable extensive analysis of the training effectiveness in improving the safety. However, the current study has generated sufficient convincing data to warrant a future comprehensive longitudinal study for determining the effectiveness of working at heights safety training course. One other improvement for the current study could have been, the inclusion of the specific evaluation studies such as knowledge test and other safety climate tests to collect quantitative data for accurate monitoring of the improvement due to the training. This type of analysis would require larger sample size, additional questionnaires and cooperating participants. In addition, this would have extended the duration of the study.

This is a single case study which is strictly reliant on self-reported assessments by the workers themselves. There was no opportunity to compare the results to a "gold standard randomized control study". However, by utilizing multiple perspectives such as surveys from the managers, regulators (inspectors), and ACC (the organization that deals with injuries), the study could have been strengthened.

The current study entirely focused on the results of the survey. Since it is known that majority of the participants are "pro-safety" respondents, there is always a danger of "non-response bias" and hence the results could seem more positive than they should be. One way to overcome this problem is to increase the participation rate by offering financial incentive for the participation.

One other issue that can be regarded as a limitation in this study is the representativeness. For this study, all the employees were recruited from one training company that is Vertical Horizonz. At this stage, it is not known how typical their training program is relative to other training programs in Waikato and New Zealand wide. Participation/recruitment of employees/trainees from other training providers would have further strengthened the data. In this study, there could be limitations with the measurement of work practices in the survey. As mentioned above the results of the study were based on the self-reported answers. It is possible that the results presented here could have a bias towards " social desirability" (choosing a more positive "pro-safety" answer rather than a poor safety answer). One way to overcome such bias would be to include multiple evaluations from the managers and inspectors. Another alternative would be to conduct an on field observation of the participants that may allow for accurate assessments.

One other limitation in the current study is the lack of data from ACC on the injury claims by the VHNZ trained employees. Such data and further co-relative analysis would have shed light on the effectiveness of the training on the outcomes such as injury prevention.

Although the stakeholders are really concerned about the fall fatalities in New Zealand, the current study was unable to use the fall fatalities data to measure the impact of VHNZ training interventions and effectiveness in preventing fatalities. From the statistical point of view, fall fatalities are low in number and therefore pose a challenge in using it as a "true" measure of the training effectiveness.

6 Chapter Six: Implications of the current Study

This research explored how the working at heights training is effective and therefore, influenced the safety outcomes at a place of work. Specifically, the study focused on finding out the effectiveness of the training on improving the safety knowledge, safety behaviour, confidence and commitment to the safety by the workers, risk acceptance, work practices, facilitating factors and reducing hindrance factors. The findings confirmed that the training was very effective in improving the knowledge about the safety in the workers. Improved knowledge of the trained workers further led to better safety behaviour, resulting in good safety attitude of the employees who rejected risks and developed excellent work practices. The findings also proved that the training was effective in reducing personal hindrance factors and improving personal facilitating factors and belief that the safety takes priority over productivity.

There are several positive implications of the study. It is a known fact that "knowledge" is key for the successful implementation of the safety rules and most of the safety infringements occur due to ignorance. So, improving the safety knowledge will lead to personal responsibility and attitude which will further lead to the safe working environment and culture. This further implies that the workers with the knowledge of safety would invariably stop co-workers from taking risks and therefore reduce injuries and improve the safety record. Another implication of the present study is that the employees need to undergo appropriate and pertinent job specific safety training. For example, a simple generic health and safety course is not sufficient for an employee who needs to work at heights. Employees who plan to seek employment in working at heights industry need to undergo a job specific working at heights training program. Depending on the risks involved, the training program should be able to provide hands on job specific safety course. One of the major findings of the study is that the training reduces the risky behaviour.

Therefore, the appropriate training is one of the really effective ways to reduce accidents at work place.

6.1 Implications for Vertical Horizonz

The outcome of the current study has implications specifically for Vertical Horizonz New Zealand. Currently the training program offered by the VHNZ is a generic working at heights training program. Given the intricacies and specialization, one of the recommendations for VHNZ is that the trainings needs to be specifically targeted for the issues identified for specific industry such as construction and mountaineering.

From this study and other literature, it is clear that new safety equipment is being introduced at a rapid pace. To keep pace with it, the VHNZ needs to update its content and the safety knowledge periodically. In order to do this ,VHNZ needs to undertake appraisals of the health and safety in different working at heights industries to identify the training needs. This process needs to be embedded in to the VHNZ organizational structure as an annual or biannual occurrence so that it would become a process to update the training protocols.

In the current study, the post-training survey was conducted on the employees that have worked for 6 Months, 12 Months or 24 Months post-training. Many parameters tested pointed out that the employees were able to retain the knowledge acquired during the training for the 24 months period. Furthermore, the survey pointed out that during the post-training period many of the employees have gone through “refresher training”. Therefore, it appears that the ‘refresher training’ plays a key role in retaining safety knowledge. However, it does not appear that the refresher course is compulsory. Hence, one other implication of this study for VHNZ is to come up with standard guidelines for the “periodicity” of the refresher training and provide that at appropriate times.

The results of the current study reveal that the training is viewed by the workers as a source of the safety knowledge and therefore, the training is viewed as a means to improve the safety knowledge by many employees. Furthermore, the study also revealed that having a good safety knowledge leads to improvements in the safety climate and attitude. Therefore, the implications of this study for VHNZ is that, they need to expand the safety knowledge to include more information on the hazard identification, safety climate and safety attitude. Given the key role played by the safety knowledge, it will be critical for VHNZ to conduct a test at the end of the training to gauge the knowledge of safety acquired by the employees. This will enable VHNZ to appraise if the employees have acquired sufficient safety knowledge and indicate to the employees the areas that need improving. The ongoing use of such appraisal system would enable them to identify and implement additional interventions over time and enable the employees to gain sufficient length and breadth of the safety knowledge to successfully reduce work place injuries and fatalities.

One of the outcomes of this study revealed that for a good safety climate at a work place, it is critical that the employees have positive work safety attitude, good behaviour, not accept risks and have a lasting commitment to the safety with good work practices. Details of the job specific good work practices, attitudes and behaviours need to be incorporated into working at heights-Advanced course.

Training is often viewed as a safety measure for the employees only. The current study pointed out the critical role played by managers and management in lending support and implementation of the safety at the work place. Given the importance, it is recommended that VHNZ initiate an entirely separate course for the managers. The course content not only should include the basics about working at heights safety knowledge information but it should also emphasize on the role played by the management in implementing the safety at work and their responsibilities. The course should also discuss the possible “hindrance”

factors that could arise from inept management and hinder implementation of the safety regulations leading to accidents and deaths. Furthermore, the knowledge on how to "facilitate" implementation of the safety regulations at work need to be included in the manager specific course work.

One of the outcomes from "hindrance" factor analysis showed that on some occasions the required resources were not allocated towards implementation of the safety by the management. VHNZ needs to discuss the resource allocation issue with the workers and the managers during the training and point out the catastrophic loss of life and financial liability that could occur in case the resources are not made available.

The responses to several questions in the survey point out that the safety attitude of the workers play a major role in the safety climate and that training is effective in inculcating positive safety attitude in the workers. Therefore, the training is invaluable, thus VHNZ should emphasize that the training should not be considered as an "expense" but it should be considered as an investment into employee health and well-being and as a means to increase productivity. In addition, VHNZ should emphasize on this point in the manager specific heights training program discussed above.

The current study emphatically shows that close to 85-90% of the post-training respondents agree that training is useful and that it improves their safety knowledge, safety behaviour, safety attitude and commitment and work practices. The survey also shows that, majority (~85%) of the employees also believe that training made them not to take risks. Despite all this positivity, the survey does point out that close to 10-15% of the employees do not agree that the training is useful. Therefore, training organizations need to use the questionnaires to identify these 10-15% worker cohort, obtain feedback and make necessary changes in the training program.

6.2 Future work

Current study is one of the first attempts to understand the effectiveness of working at heights training provided by a commercial company (VHNZ) in New Zealand. The methodological limitations of this study need to be considered when designing future research. This study has definitely set a foundation for research on determining the effectiveness of training on the safety at work place. It has raised many initial hypotheses. A few research areas can be further explored as a result of this study.

The methodology used in this study is to compare the results of the pre-training and the post-training cohorts to decipher the effectiveness of the training on safety outcomes at work. Since this is a Master's thesis, with limited time and resources, a longitudinal study was not possible. However, this study has generated sufficient convincing data to warrant a future comprehensive longitudinal study for determining the effectiveness of working at heights safety training course. Specifically, a longitudinal study needs to be designed to monitor the effectiveness of training in not only imparting knowledge and improving safety climate, but also practically reducing accidents. Given that the accident rates are still persistent in the construction industry, it is preferable to focus the future study on the construction industry. For the design of the study, 200-500 working at heights training naïve prospective construction workers need to be recruited and baseline data on the safety knowledge, safety behaviour, safety climate, and safety attitude along with data on work practices need to be collected. These workers then need to be followed for at least 2 years post-training, for their knowledge retention, safety behaviour and attitude along with accident rates associated with them.

One other aspect that needs to be tested in the longitudinal study is the identification of the factors that would help the employees to maintain good work practices and safety attitude. One important factor that could be tested for the knowledge retention in the

longitudinal study is the importance of the "refresher" training for the employees. In future, the study may determine (i) if the "refresher" training is more effective in the knowledge retention over time (ii) if so, how often should the refresher training be offered. Although the construction industry has tremendously improved their safety record, it is still plagued by accidents. So, another aspect that needs to be investigated in the longitudinal study is the reason for the continued mishaps in construction industry and how constant training/and or monitoring would help alleviate the near misses and accidents.

As discovered in the current study, the managers/ and supervisors play a pivotal role in the implementation of the safety regulations. However, it is also important to realize that supervisor's role is influenced by the organizational structure and personal characteristics of the supervisor. So another interesting future research project therefore would be to investigate how the individual similarities and differences in personal characteristics of supervisors influence the outcomes of the training programs within an organisation.

The findings of this study are completely derived from the sample taken from one training provider. To fully understand the effectiveness of training, more training providers need to be used in the future study. Similarly, the current study participants are predominately from the construction industry. To get a global perspective on the training effectiveness on working at heights, workers from other professions such as mountain climbing and turbine workers need to be recruited and studied.

Future research can be done to find out the best method for delivering training. From this study, it cannot be concluded what is the best delivery method. There are several methods and tools used in imparting knowledge during training. They include lectures, hands on training, demonstrations and role playing. An independent study would be required to determine which combinations of the training methods would work the best for working at heights training. New Zealand work force has become multi-racial and multi-cultural.

Therefore, a future study that would identify the contribution of learning culture, motivation and medium of the instruction in training effectiveness is both timely and essential.

Future studies can be extended towards the understanding of the role of Human Resource facilitating factors such as promotion policy, allowances and perks on long term safety commitment of the employees in an organisation.

After initial training of the employees, organisations should periodically conduct follow-up assessments to make sure that the training content is retained over the time. Hence, one of the future studies could be to determine the effectiveness of constant monitoring by the organisation in retaining the safety knowledge by their employees.

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8 Appendix A

PRETRAINING QUESTIONNAIRE

Please answer all questions so that the survey data will be complete. Please answer honestly so the research will be accurate. Remember, no one outside of the research team will see your individual answers. This is your opportunity to give your true views.

1. **Do you consent to your responses being included in this research, under the conditions in the Participant Information Sheet?**

   □ Yes □ No

2. **At present, how often do you check the worksite for work at height hazards at the beginning of the shift?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

3. **At present, how often do you inspect your height safety equipment before using it?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

4. **At present, how often do you work without suitable height safety equipment?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

5. **At present, how often do you maintain three-point contact when using a ladder?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

6. **At present, how often do you take a shortcut to save time, even though it increases chances of injury?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

7. **At present, how often would you raise your safety concerns in meeting with your supervisor/manager?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

8. **At present, how often would you raise your safety concerns with your co-worker?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

9. **At present, how often do you get job specific 'working at heights' training before the start of each job?**

   □ Always □ Usually □ Sometimes □ Occasionally □ Never

10. **At present, how often are you given the fall rescue plan before the start of each job?**

□ Always □ Usually □ Sometimes □ Occasionally □ Never/Not Applicable

11. **At present, how often do you use guardrails instead of a fall arrest system?**

□ Always □ Usually □ Sometimes □ Occasionally □ Never/Not Applicable

12. **At present, how often do you use seat belts when travelling to, from or around worksites?**

□ Always □ Usually □ Sometimes □ Occasionally □ Never/Not Applicable

13. **To what extent are you expecting your heights training to be useful in doing your work?**

□ Extremely useful
□ Very useful
□ Moderately useful
□ Slightly useful
□ Not at all useful

14. **Who paid for the working at heights training?**

□ I Paid
□ My Union Paid
□ My Employer Paid
□ My Employer and I Shared the cost

15. **Before this training, have you ever done a formal heights safety training?**

□ Yes □ No

16. **Do you belong to a union?**

□ Yes □ No

17. **What is your gender?**

□ Male □ Female

18. **What is your age?**

- Under 15 years
- 15 to 24 years
- 25 to 34 years
- 35 to 44 years
- 45 to 54 years
- 55 to 64 years
- 65 years and over

19. **In which industry does your business operate?**

- Financial and Insurance Services
- Arts, Recreation and Other Services
- Manufacturing
- Electricity, Gas, Water and Waste Services
- Construction
- Wholesale Trade
- Retail Trade and Accommodation
- Transport, Postal and Warehousing
- Information Media and Telecommunications
- Rental, Hiring and Real Estate Services
- Professional, Scientific, Technical, Administrative and Support Services
- Public Administration and Safety
- Education and Training
- Health Care and Social Assistance

20. **How much experience do you have in working at heights?**

- A great deal
- A lot
- A moderate amount
- A little
- None at all

9 Appendix B

Post-Training Survey

Start of Block: Imported Block 1 - Sep 3, 2019

Please answer all questions so that the survey data will be complete. Please answer honestly so the research will be accurate. Remember, no one outside of the research team will see your individual answers. This is your opportunity to give your true views.

Do you consent to your responses being included in this research, under the conditions in the Participant Information Sheet? Participant Information Sheet.pdf

- ☐ Yes
- ☐ No

KNOWLEDGE

These set of questions will test improvement in knowledge of working safely at heights as a result of training.

1 I learnt new information about how to work safely at heights during training.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

2 The training improved my knowledge about using ladders safely.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

3 The training improved my knowledge about when to attach to a height safety system.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

4 The training improved my knowledge in identifying suitable anchor points.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

5 The training improved my knowledge about general safety practices.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

6 The training improved my knowledge when selecting and tying an appropriate knot.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

7 The training improved my knowledge when selecting a height safety system.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

8 The training improved my knowledge about selecting height safety equipment for different scenarios.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Page Break

BEHAVIOUR

These set of questions will test improvement in your behaviour towards working safely at heights as a result of training.

9 As a result of heights training, I will change the way I take safety precautions.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

10 As a result of heights training, I assess height safety risks before beginning a job.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

11 As a result of heights training, I inspect all height safety equipment before beginning a job.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

12 As a result of heights training, I assess the need for a rescue plan before beginning a job.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

13 As a result of heights training, I have ordered new height safety equipment.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

14 As a result of heights training, I use an industrial safety helmet when conducting work at heights.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

Page Break

CONFIDENCE AND AWARENESS

These set of questions will test improvement in your confidence and awareness of working safely at heights as a result of training.

15 As a result of heights training, I am confident in applying the height safety skills.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

16 As a result of heights training, I am now confident that my height safety practices are legally compliant.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

17 As a result of heights training, I am now confident of raising safety concerns with my supervisor or manager.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

18 As a result of heights training, I am now confident of stopping a colleague from doing an unsafe height safety practice.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

19 As a result of heights training, I feel confident fitting a height safety harness.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

20 As a result of heights training, I feel confident about identifying whether height safety equipment adheres to relevant standards.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Page Break

SAFETY COMMITMENT

These set of questions will test improvement in your safety commitment as a result of training.

21 As a result of heights training, I am not embarrassed to ask a safety question.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

22 As a result of heights training, I now consider safety more important than getting the job done quickly.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

23 As a result of heights training, I now report unsafe practices whenever I see them.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

24 As a result of heights training, I believe that safety rules cannot be disregarded even when nearing the end of the shift.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Page Break

RISK ACCEPTANCE

These set of questions will test your tendency to accept health and safety risks.

25 I perform jobs for which I do not have required knowledge/training.

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

26 If PPE is not made available to me, I work without them.

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

27 I work without all necessary protection to increase my productivity.

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

Page Break

WORK PRACTICES

These set of questions will test improvement in your work practices as a result of training.

28 Since your training, how often have you used height safety protection equipment that has expired?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

29 Since your training, how often have you maintained three-point contact when using a ladder?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

30 Since your training, how often have you been taking shortcuts to save time, even though there was a chance of falling?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

31 Since your training, how often have you discussed any concerns about height safety equipment with your supervisor/manager?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

32 Since your training, how often have you raised any safety concerns about height safety with your co-workers?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

33 Since your training, how often were you aware of the fall rescue plan before starting the job?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

34 Since your training, how often did you use guardrails instead of a fall arrest system?

- ○ Always
- ○ Usually
- ○ Sometimes
- ○ Occasionally
- ○ Never

Page Break

RISK AND ACCIDENT REDUCTION These set of questions will test your ability to reduce risks and accidents while working at height as a result of training.

35 Since training, I do not take even small risks that can lead to accidents.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

36 Since training, I do not perform jobs for which I do not have required knowledge/training.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

37 Since training, I do not work without PPE.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

38 Since training, I never work without all necessary protection.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

39 Since training, my work practices are much safer now.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Page Break

HINDRANCE FACTORS In this section, we want to learn about the difficulties you have experienced in applying some of the things learned during your training.

40 I find it hard to apply what I learned in the 'working at heights' training, because the equipment is not available at work.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

41 I can't always replace my height safety equipment when I should, because it is expensive and not readily available at work.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

Personal Hindrance Factors

43 I find it hard to apply what I learned in the training, because there is too much to remember.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

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44 I don't wear the fall arrest harness when I should, because it is uncomfortable.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

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46 I don't follow what I learned in the training, because working at heights is a risky business any way and no amount of training is going to reduce the risk.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

---

47 I don't follow what I learned in the training, because accidents hardly ever happen.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

48 I don't follow what I learned in the training, because the training is conducted only to satisfy 'Worksafe'.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

Time Hindrance

49 I find it hard to apply what I learned in the 'working at heights' training, because I don't have the time to inspect my fall protection equipment before using it.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

50 I don't use height safety equipment when I should, because it slows down my work.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Work place environment hindrance

51 I don't follow fall prevention procedures learned in the 'working at heights' training because other co-workers do not follow fall prevention procedures.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

52 I don't follow fall prevention procedures learned in the 'working at heights' training because of my supervisor's relaxed attitude.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

53 I don't follow fall prevention procedures learned in the 'working at heights' training because there are no clear rules around fall prevention at my place of work.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Page Break

FACILITATORS

In this section, we want to learn about the factors that helped you in applying some of the things learned during your training.

Resource Factors

55 Adequate money is available to purchase and use safety equipment at my work.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

56 Periodical audits are conducted to promote safe working at heights.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Q205 *Management Factors*

57 Our management strictly enforces height safety regulations.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

58 Our management promotes high level of support for safety and fall prevention.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

60 Our management supports self-reporting of accidents and near misses.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

Personal Factors

61 I am aware that I need to follow height safety rules when I am working at heights.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

62 I should always follow safety rules around fall prevention even when it takes longer to do the job.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

63 I believe in having a safety culture and this helps in height safety.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

64 I raise awareness of safety and fall prevention rules with my colleagues.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

65 I raise awareness of safety and fall prevention rules with my supervisors.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

66 I believe that if every employee follows height safety procedures, it will reduce accidents.

- ○ Strongly Agree
- ○ Agree
- ○ Disagree
- ○ Strongly disagree

67 In my opinion reporting accidents/incidents and near misses help us to improve safety.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

Relationship Factors

71 Co-workers encourage each other to follow safety and fall prevention protocols at my company.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

72 Employees at my company are not ridiculed if they follow safety and fall prevention protocols.

- Strongly Agree
- Agree
- Disagree
- Strongly disagree

Page Break

Q204 **STATISTICAL DATA**

74 Who pays for your fall arrest harness?

- I pay
- My company pays
- We share the cost
- Not applicable

77 Was this your first height safety training?

- Yes
- No

Display This Question:
If Was this your first height safety training? = No

79 When was your last refresher course?

- 0 - 1 year ago
- 1 - 2 years ago
- More than 2 years

80 What is your age?

▼ Under 15 years ... 65 years and over

81 In which industry does your business operate? Choose from the drop down list.

▼ Financial and Insurance Services ... Health Care and Social Assistance

82 How much experience do you have in working at heights?

- ○ A lot
- ○ A moderate amount
- ○ A little
- ○ Not at all

83 What is your gender

- ○ Male
- ○ Female

End of Block: Imported Block 1 - Sep 3, 2019

10 Appendix C

Participant Information Sheet

Waikato Management School
Te Raupapa

THE UNIVERSITY OF WAIKATO
Te Whare Wānanga o Waikato

A study is being conducted to assess the effectiveness of "Working at Heights" training offered by Vertical Horizonz. The study is conducted by University of Waikato student Dr. Ravi Kambadur and Professor Mark Harcourt in collaboration with Vertical Horizonz CEO Ben Johnstone. To help complete the research program, the researchers are recruiting workers (the employees) undergoing training and their employers. Participants who want to participate in the study are requested to fill out a questionnaire that will ask various questions on the details of the training program and how effective the training program is in improving the safety of workers and prevention of falls. The questionnaire will take up to 15 minutes to complete. The employee can withdraw from the study at any time. The identity of the employee (worker)/employer is kept confidential as it is an anonymous survey. The survey can be done on a paper questionnaire or online using a computer. The data will be safely kept on Waikato
University computers and will be protected by Waikato University computer security and firewall. Only Professor Mark Harcourt and his student Ravi Kambadur will have access to this data. After the analysis the data will be published as a research thesis and as a journal article with absolute confidentiality. At no time the identity of the participant will be revealed. The data will be retained for 5 years.

The participants have the right to ask any questions about the research and have them answered to their satisfaction. In addition, the participants also have the right not to answer any question.

Ravi Kambadur and Professor Mark Harcourt can be contacted via the following:

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