

# An Overview of Limitations Related to Constructions Safety Measures and Performance in New Zealand

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## ABSTRACT

The construction industry is amongst the feasible investment that just as promising as other sectors such as fishery, mining, manufacturing, forestry, and agriculture. In New Zealand, construction emerged as the fifth significant sector and offer employment for more than 7.6% of the national workforces in 2013, which is 30% higher compared to 2002. The establishment of 'National Action Agenda 2010-2013' is a continuity approach to meet the 'Workplace Health and Safety Strategy for New Zealand to 2015'. These milestones are aligned to achieve a greater goal by the year 2020, where the government targeted 25% reduction of cases and positively by 2023, this country will emerge as one of the safest places to be employed (*Department of Labour, 2010*). A conceptual modeling by Dumrak et al (2013) provides guideline to narrow down the secondary data collected and keeps the focus of study. From literature, the key drivers and factors contributed to health and safety performance is identified. By analyzing the common injuries reported, the clue towards barriers to safety measure strategy should be expected. Essentially, the limitations related to safety measures are revealed thus minimizing the obstruction in achieving the national objective.

**Key Words:** Construction accidents, Workplace injury, Safety measures

## 1. INTRODUCTION

The construction industry is amongst the feasible investment that just as promising as other sectors such as fishery, mining, manufacturing, forestry, and agriculture. In New Zealand, construction emerged as the fifth significant sector and offer employment for more than 7.6% of the national workforces in 2013, which is 30% higher compared to 2002 (*The Ministry of Business Innovation & Employment (MBIE), 2013*). The workforces in New Zealand construction industry supplies assortments level of human resources, starting from general laborers and tradesmen up to the professional consultants such as engineers and project managers. In 2011, the numbers of construction workers were greater compared to agriculture, forestry and fishery sectors. The situation results from the advancement of external global economic and internally, it is triggered by the devastating Canterbury earthquake in the year 2010. Subsequently, the government has facilitated a recovery fund worth more than 5 billion dollars to re-develop public infrastructure and amenities, such as providing new hospital and a convention center in Canterbury. In the same year, the industry contributed about 6.3% of the national GDP after experiencing an economic downturn previously. (*The Ministry of Business Innovation & Employment (MBIE), 2013*). After the Pike River Coal Mine bitter tragedy in November 2010, New Zealand government is being more adamant over workplace safety measures. The tragedy killed twenty-nine miners and their bodies have not been recovered. (*Royal Commission on the Pike River Coal Mine Tragedy, 2012*). The event draws the nation to re-evaluate regulations and existing prevention measures for safety in the workplace. An independent agency known as The Taskforce on Workplace Health and Safety (the Taskforce), has been established in 2012 to advise on methods in reducing the rate of fatalities and injuries by at least 25% by the year 2020 (*Department of Labour, 2013*). Another independent Crown agent known as WorkSafe New Zealand (NZ) has been set up in December 2013 to improve New Zealand's health and safety performance. The agency works collaboratively with Ministry of Business, Innovation, and Employment (MBIE) to promote and enforces regulations in good safety practices. WorkSafe NZ has the ability to make recommendations on legislative change and play a major role in the development of a health and safety

strategy. Similar governance has also been structured for New Zealand's maritime and aviation to extend the workplace safety measures thoroughly the industries.

### 1.1 Problems Statement

Despite the relentless promotions, awareness and enforcement carried out, studies keep pointing construction sector as one of the major contributors to workplace accident and injuries. The complexity a construction work itself does not warrant a total injury-free environment. Accident Compensation Corporation (ACC) statistic reveals that construction industry is among major sources of work-related claims in 2015. At 14.9 %, the industry falls second behind manufacturing industries (ACC, 2015) Several articles also discussing the similar issues thus alerting the need to refine and re-evaluate the current safety procedures and existing prevention measures related to construction safety as shown in Figure 1.2.

Claims for work-related injuries								
By industry								
2009–15								
Industry grouping (ANZSIC 2006)	2009	2010	2011	2012	2013	2014	2015	2015 RANKING
Percentage (%)								
1 Agriculture, forestry, and fishing	10.2	10.6	10.6	12.4	12	11.4	11.1	3
2 Mining	0.4	0.3	0.3	0.3	0.3	0.3	0.2	
3 Manufacturing	17.6	17.1	17.1	17.8	17.4	17.2	16.7	1
4 Electricity, gas, water, and waste services	1.1	1.1	1.2	1.1	1.1	1.1	1.1	
5 <b>Construction</b>	<b>12.6</b>	<b>12.6</b>	<b>12.2</b>	<b>13.4</b>	<b>14.1</b>	<b>14.4</b>	<b>14.9</b>	<b>2</b>
6 Wholesale trade	3.1	3.1	3.3	3.5	3.4	3.5	3.5	
7 Retail trade	6.3	6.3	6.3	6.7	6.7	6.5	6.6	
8 Accommodation and food services	3.5	3.6	3.8	4.3	4.3	4.3	4.3	
9 Transport, postal, and warehousing	4.7	4.7	4.7	5	5	5	5.1	
10 Information media and telecommunications	0.7	0.6	0.5	0.4	0.4	0.3	0.3	

Figure 1.1: Claims of Work-Related Injuries in 2015

Source: (ACC, 2015)



Figure 1.2: News Article Reporting Accident Claims

Source: (Allen, 2017) & (Edmunds, 2015)

### 1.2 Research Questions

This general overview is carried out to understand the situation or barriers which possibly may restrict the reduction of accidents and injuries in the sector. Findings to the following questions are expected at the end of the study.

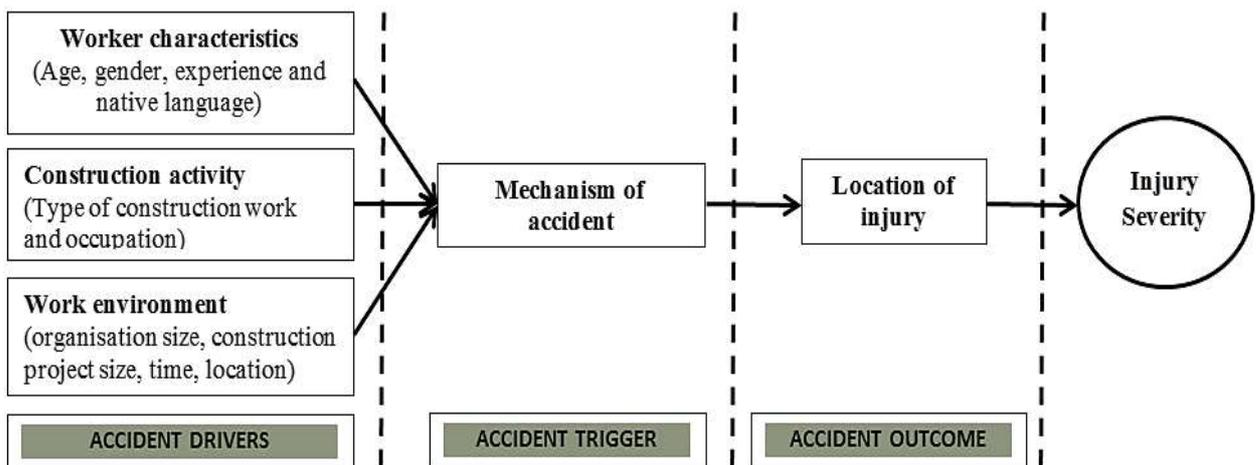
- To identify the common construction injury occurred in New Zealand
- To distinguish the limitations in the safety measures performance.

### 1.3 Scope of Study

The study is focusing on the key drivers influencing construction safety performance and comprises with relevant departments authorized in the field. The analyses are respectively based on the data reveals by other official bodies and agencies significant to constructions sector.

## 2. LITERATURE REVIEW

Typically, projects stakeholders are concern towards construction injury because apart of the apprehension from a legislative penalty, the incidence will delay the progress of a project, decrease productivity, increase costs and portray negative reputation toward the builder (Dumrak, Mostafa, Kamardeen, & Rameezdeen, 2013). Several articles mentioned about factors and drivers which lead to construction injury and fatality. Gangoells et al. (2010) reveals how safety in the industry could be improved by studying the relationship between risks (or the injury mechanism) with the construction activities, whilst Hinze et al. (2005) and Choudhry and Fang (2008) pointing factors which include human errors as cause of the accidents (Dumrak et al., 2013). Gunby (2011) stated that the key driver in health and safety issues includes employment demographic patterns, awareness and the public's attitudes toward regulations (Gunby, 2011). Chi et al. (2013) associating the issue with unsafe acts, unsafe work conditions and types of injuries to clarify the level of accident severity (Dumrak et al., 2013). The conceptual modeling shown below provides a guideline to narrow down the literature collected within three main focuses, that is; worker characteristics, construction activity, and environment.



**Figure 2.1:** Conceptual Model of Construction Injury Severity  
Source: (Dumrak et al., 2013)

There are numbers of accident causation models which could be applied by the field expert such as Rasumussen's Work Behavior Model, Human Information Processing Model, Epidemiological Model and Systems Model of Construction Accident Causation (Li & Poon, 2013b). As for the construction workers, being part the 'promising-paid' employment also means that they are exposed to all work-related risks in the industries. According to (Li & Poon, 2013b), there are two causes of accidents such as listed in following sub-topics.



**Figure 2.2:** Causes of Construction Accidents  
Source: (Li & Poon, 2013b)

## 1.4 Direct Causes of Injury

- a) Site Condition and ergonomics – a proper layout will assist to safety in the workplace. Good coordination and housekeeping in the construction site is a form of simple protection measures to avoid any preventable accident.
- b) Weather – The weather conditions influence the whole activity and reflect the productivity of the workers. Understanding the site condition will determine total break-time for the worker thus reducing the potential for stress and fatigue.

## 1.5 Indirect Causes of Injury

- a) Human factor – misjudgment, incorrect decision and mistake due to inexperience in the task carried out leads to workplace injuries. Interconnection with teammates, training, and education is crucial in creating the safe environment. Combination of wellness in physical and positive physiological level is also important.
- b) Economics – the effect will be dissimilar depending on the background status, as a developed or developing country. Methods of a payment motives builder to embark on fast-track project are riskier since they tend to focus less on safety aspects.
- c) Hectic Schedule – approaching dateline and time overrun normally caused a hectic schedule and resulting carelessness, distraction, fatigue, and miscommunication.
- d) Organisational factors – the scale and state of the organization such as subcontracting, size of the firm and engagement of temporary resources could create difficulties between staffs and leads to a higher unsafe situation.
- e) Legislation & enforcement – as law and rules exist to safeguard all parties in the industry, it is also crucial to ensure the government target can be accomplished. The specific clauses and provision are significant to enforce a valid fine and penalty.
- f) Insufficient data – statistic and previous data are vital to assess the whole performance of health and safety system in order to strategized improvement.

Financially, direct cost includes monetary compensation, financial loss for the country's health care and injured workers' loss of working capacity. The cost that is not covered by insurance was termed indirect or hidden costs. They include sick leave pay, the production setbacks, non-productive time of colleagues, administrative costs, fines and investments in extra safety measures and replacement hiring costs (*Li & Poon, 2013a*).

## 1.6 Construction Activities in New Zealand

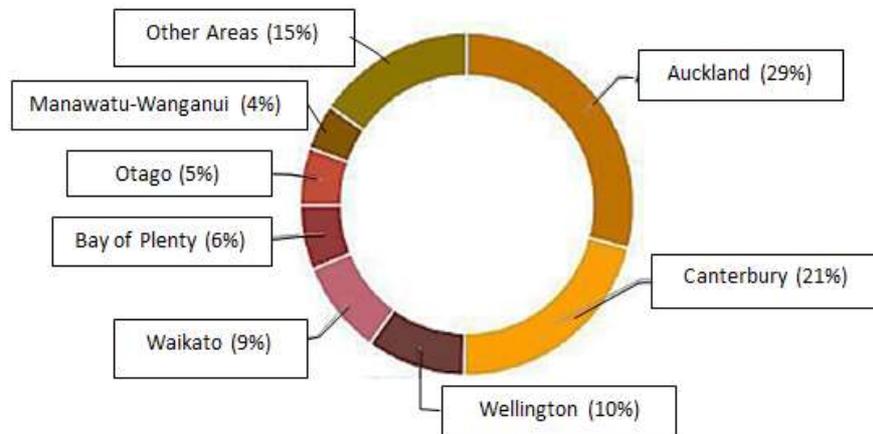
Construction activity in New Zealand is more prominent in Auckland, Canterbury, and Wellington that contributed to 60% of total the industry national employment. Despite the situation, Auckland region still facing a large shortfall in labor demands required for both residential and non-residential projects (*Rice & Shewan, 2016*). New Zealand construction's industries are economically divided into these sub-sectors depending on the project's nature, namely;

- a) Building installation services – covers all related services such as plumbing, electrical services, fire hazards, installations of heating, ventilation, and air-conditioning (HVAC).
- b) Heavy and civil engineering construction – involves with civil engineering projects such as road, bridge, dam and etc.
- c) Residential building construction – associated with building houses, apartments, alterations works, renovation of houses and etc.
- d) Building completion services – related to carpentry services, tiling and carpeting services, glazing, painting, decorating services and etc. (*Rice & Shewan, 2016*)

The current applicable standard forms include the revised of New Zealand Standard (NZS) 3910:2013 for the construction project, NZS 3916:2013 forms for design and build purpose and NZS 3917:2013 for the fixed term project. The latest forms refine provisions for commercial construction contract and comprise new guidelines which are more simple to fulfill. Regardless of the revisions, the NZS3910 continue to be the common form applied to the country (*Gillies & Henry, 2015*). In April 2016, the previous Health and Safety Employment Act 1992 has officially been replaced by the new legislation known as The Health and Safety at Work Act 2015. This indicates the government commitment to ensure the national objectives towards health and safety issue will be accomplished. The new regulations gives more responsibility to employers in keeping their workers safe and enable the employee to have more participation in the safety matters. Other by reforming sets of regulations and law provisions, several significant agencies have also

been established in order to promote, supervise and monitor the areas of concern. Amongst the newly established agencies are such as;

- Workplace Health & Safety Council—established in 2007, assisting in leadership, coordination, advice, standard and policies. Source: (*whss@dol.govt.nz*)
- The Independent Taskforce (for Workplace Safety & Health) – established in 2012, providing an assessment of the local workplace safety condition and recommend prevention strategies towards injury and fatality. Source: (*The Independent Taskforce on Workplace Health & Safety, 2013*)
- WorkSafe New Zealand – operating in 2013, another regulatory agency as a direct response from the Royal Commission of Inquiry (subsequent from Pike River Mine Tragedy). Source: (*New Zealand Worksafe., n.d.*)



**Figure 2.3:** Full Total Employments by Region in 2015  
Source: (*Rice & Shewan, 2016*)

## 1.7 Demographic of Construction Workforces

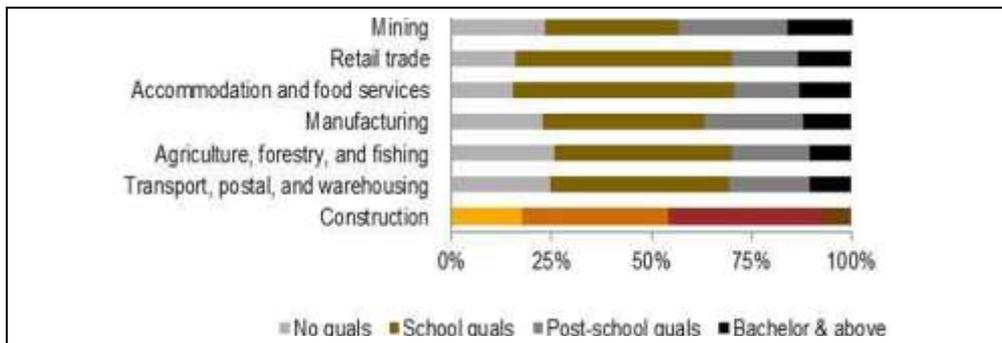
This sub-topic describes some characteristic of human resources involves in the construction industry. Similarly to other nations, New Zealand's construction is mainly led by the male; statistically over 8 out of 10 are a male worker (*Worksafe New Zealand, 2015*). However, this amount has been narrowing since 2005. In March 2015, there is an additional 5887 female workforce in the industry compared to the past ten years (*Rice & Shewan, 2016*).

**Table 2.1:** Recent Immigrants Origin  
Source: (*MBIE, 2015*)

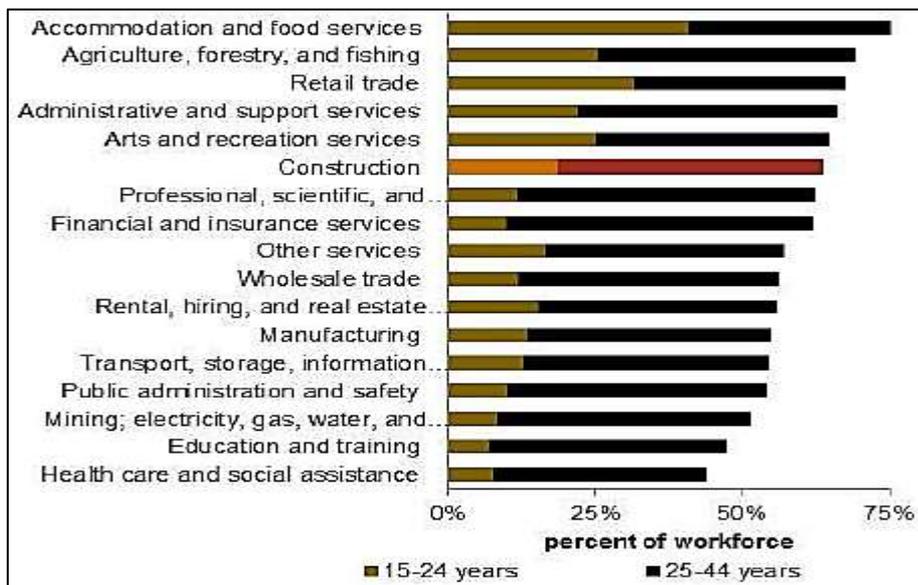
		2012	2013	2014	2015
Country	UK/Ireland	19%	18%	18%	16%
	China	11%	12%	13%	12%
	India	11%	12%	11%	12%
	Philippines	7%	7%	7%	6%
	United States	7%	6%	5%	5%
	Fiji	5%	5%	3%	3%
	South Africa	5%	3%	5%	2%
	Other	36%	36%	38%	43%
Origin	Asia	41%	42%	42%	42%
	Europe	34%	36%	36%	37%
	North America	9%	8%	9%	9%
	Oceania	7%	6%	6%	5%
	Africa	5%	4%	5%	3%
	South America	3%	3%	3%	3%

The construction report shows an evidence of diversity in the workforce's background and ethnicity. From the total of 19 industries surveyed, construction is ranked at the 8<sup>th</sup> highest proportions of workers identified as Maori or Pacific-people (*Rice & Shewan, 2016*). Due to reconstruction activities in Canterbury and economic expansion in other regions, the local construction industry is now facing a significant shortage of human workforces (*Rice & Shewan, 2016*). This current demand topping up to the existing shortage factor which is caused by low physical capital investment as well as human capital (*Abbott, 2013*), resulting in the appointment of foreign workers into the assortments (*Gillies & Henry, 2015*). The following

figure shows the percentage of the general immigrant's origin group visited the country from 2012 to 2015. Thus, it can be perceived that the New Zealand's workforces are obviously multi-cultural and races blended. According to Worksafe New Zealand (2015), the proportion of construction worker employed has lower or no qualifications compared to the other industries average workforces. The government survey reveals the need for fundamental training in numeracy, literacy, and management in their comments section (*Worksafe New Zealand, 2015*). Approximately 46% of workers had a post-school qualification, Bachelor (or higher) degree in construction compared to 48% for the New Zealand average. The amount of workforce with higher technical education has grown steadily from 6800 in the year 2006 to approximately 10 000 in 2013 (*Rice & Shewan, 2016*). The information regarding background education of construction workers can be read closely with the data regarding age groups. The figure shows that for the group age of 15 and 24, construction industry falls among the highest sixth out of 17 industries in total. As for the group of age 25 and 44, it falls under the highest third (*Rice & Shewan, 2016*). It can be concluded that construction industry provides extensive chance for prospects with less working experiences and provide them with the first glimpse of employment.



**Figure 2.4:** Educational Attainment in Construction is Mid-Field  
 Source:(*Rice & Shewan, 2016*)

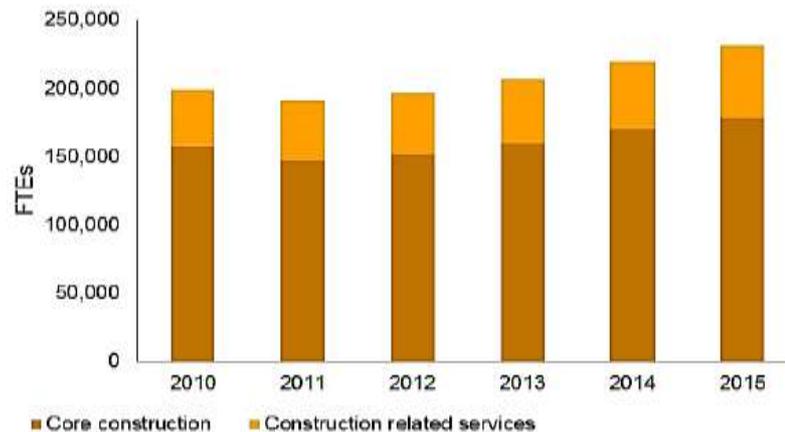


**Figure 2.5:** Comparison of Age Groups Employment between Industries  
 Source:(*Rice & Shewan, 2016*)

**1.8 Recent Constructions Setting and Environment.**

This section is reviewing current development happening in New Zealand and to look into the construction employer as suggested in the conceptual modeling by Dumrak et al. (2013). Whilst the word “recent”, is subjected to the period this study is conducted. In 2015, the estimated total of core construction company operating was up to 54 500 as illustrated by the figure below (*Rice & Shewan, 2016*). Statistic data reveals that in quarter 2014, the activity leap to 12.5% which marked the largest increase for local construction in 14 years. (*Howard, 2014*). Local constructions are dominated by small businesses and self-employed workers. The proportion is higher for building construction and construction services compared

to civil works. In 2015, about 90% of the construction companies had between 0 to 5 employees and more than 94% of the companies hired not more than 10 employees (Rice & Shewan, 2016). Economically, this condition will make an investment in recruitment and retention of skilled worker more challenging due to the demand cycle (Worksafe New Zealand, 2015).



**Figure 2.6:** Employments in Construction Since 2010

Source: (Rice & Shewan, 2016)

As mention earlier, the recent construction activities are triggered by the need to rebuild Christchurch, earthquake reinforcements, repairs of leaking buildings and catering residential demand (Gillies & Henry, 2015). The Proposed Auckland Unitary Plan permits allocation of 422 000 houses to accommodate the increasing population for another 30 years (Rice & Shewan, 2016). The infrastructure works will steadily contribute significantly for the next ten years with the forecasted value worth (NZD) \$110 billion. Currently, the National Construction Pipeline is the central attention undertaken for infrastructure project (Gillies & Henry, 2015). The mounting development can be seen through the climbing numbers for building consent from 2011 to 2015.

**Table 2.2:** Growth of Building Consents from 2011-2015

Source: (Rice & Shewan, 2016)

Region	Change In The Value Of Building Consent
Auckland	14%
Wellington	3%
Canterbury	33%
Rest of NZ	9%

### 3. RESEARCH METHOD

The methodology involves with gathering related information's to strengthen the fundamentals knowledge about the subject. The inputs were obtained from printed publications and other online sources such as;

- a) Books
- b) Press release
- c) Newspaper articles
- d) Magazines
- e) Websites of related agencies

The origins of resources also vary in terms of authors, reports or professional bodies gazette, manuals, and annual reports. The data revealed by the local ministry and authorities will be analyzed to meet the research questions.

## 4. FINDINGS

### 4.1 Research question one:

From the Accident Compensation Corporation (ACC) claims, highest percentages are led by the specialist trades activities at 50% and residential construction falls into second place at 23% of recorded claims. Specialist trades involves with services that support the completion of the project construction such as plumber, electricians, roofers, and painters. Civil engineering works show slight differences at 21% compares to residential works.

**Table 4.1: Injury Rate as per Category**

	CIVIL	COMMERCIAL	RESIDENTIAL	SPECIALIST TRADES
Injury Rate*	17.6	17.0	22.9	19.3
Severe Injuries **	740	216	801	1764
(%) of Injuries	21%	6%	23%	50%

\* Average Annual Severe Injury Rate per 1000 in Employment (2008-2014)

\*\* Average Annual Severe Injuries (2008-2014)

The classification of these injuries according to the cause's mechanism is illustrated in the table below. The percentages also reflecting the average of working days lost due to the accident and general key factors contributing to the injury. The highest injury mechanism involves with body stressing at 39% hurting mostly shoulder parts and back spine due to lifting and moving objects. Although fall from height ranked at the second place with 15%, however, it claims most of the working days which will delay the project progress significantly. Injuries due to trips and slips also display a similar pattern, despite lower percentage of occurrence, the victim will suffer longer unproductivity period.

**Table 4.2: Injury Mechanism and Key Factors**

Injury Mechanism	(%) Number of Severe Injuries	Average Days Off Work	Key Factors
Body Stressing	39% (8066 no)	166	Open lifting – commonly shoulder and back injuries
Fall from height	15% (3055 no)	236	Commonly for ladders, stepladders (40%) and roofs (16%)
Falls, Trips & Slips	13% (2899 no)	144	Stairs / steps, holes, stepladders, worksite clutter and pose risks

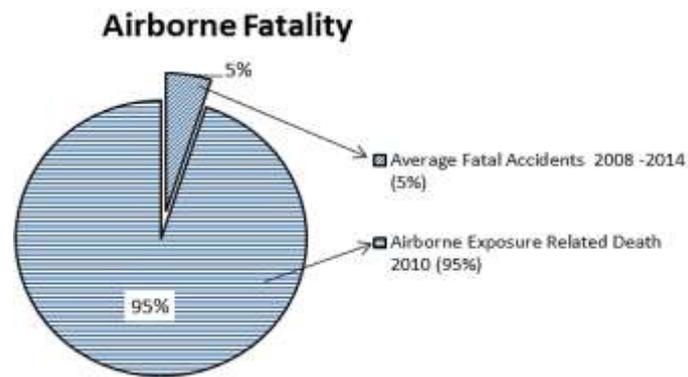
\*Severe injuries in construction sector (2008-2014)

**Table 4.3: Major Injury Sites and Claims**

Major Injury Sites	Cost (NZ Dollar)	Claims (in number)
Lower back/spine	\$18.1 mil	8154
Shoulder (clavicle/blade)	\$13.5 mil	5978
Knee	\$6.5 mil	2610
Ear	\$7.9 mil	2333
Others	\$42.3 mil	17 799
Unknown	\$10.9 mil	3310
<b>TOTAL</b>	<b>\$99.2 mil</b>	<b>40 185</b>

\* Major injury sites by active cost and active claims (Average:2008-2014)

These injuries mostly harmed several body parts such lower back side, shoulder, knee, and ear. From 2008 to 2014, the total average claims quantity are 40 185 which cost financial amount of \$99.2 million NZ dollar. An average total of 68 fatal accidents in construction from 2008 to 2014 has also discovered. However, it required more precise information and sufficient details which is not included in this paper. Causes of fatalities were mainly related to worksites safety, moving vehicles, falls from height or hit by falling objects. On the other hand, death rate related to occupational diseases shows much higher percentages compared to construction fatalities which are alarming. The causes are associated with airborne exposure to dust, asbestos, and silica from building materials and work processes undertaken.



**Figure 4.1:** Causes of Death in Construction Accident vs Occupational Diseases

## 4.2 Research questions two:

Peeling off the recent construction setting and matched to accident causes, several limitations related to health and safety can be concluded. The table shown below lists the recent circumstance in construction and how the situation limits safety prevention, perception, and strategies.

**Table 4.4:** Drivers, Circumstances and Limitations in Safety

ACCIDENT DRIVERS	RECENT CIRCUMSTANCES	LIMITATIONS IN SAFETY
Worker characteristics	<ul style="list-style-type: none"> <li>a) Age – young workers</li> <li>b) Education &amp; qualification</li> <li>c) Foreigners &amp; migration</li> </ul>	<ul style="list-style-type: none"> <li>- Less experience and competencies in handling jobs or machinery</li> <li>- Language &amp; communication</li> <li>- Issues in understanding order &amp; regulation</li> </ul>
Construction Activity	<ul style="list-style-type: none"> <li>a) New project (i.e: rebuilding Canterbury )</li> <li>b) Residential &amp; remedial works</li> <li>c) Infra works (i.e pipeline)</li> </ul>	<ul style="list-style-type: none"> <li>- Ascending injury to certain part/sides of body (i.e: knee injury)</li> <li>- Re-evaluation of regulations, policies, and governance.</li> <li>- Public training, promotions, awareness</li> </ul>
Work Environment	<ul style="list-style-type: none"> <li>a) Self-employed business</li> <li>b) Small-scale organization</li> <li>c) Shortage in labor market</li> <li>d) Natural disaster / climate</li> </ul>	<ul style="list-style-type: none"> <li>- Difficulties to make investment in recruitment and retention of skilled worker</li> <li>- Affecting personal attitudes towards safety (i.e: working non-stop)</li> <li>- Multi-tasking issues: low productivity after leaving specific job for a long time (change in technology, age &amp; etc)</li> </ul>

## 5. DISCUSSIONS

- a) The efficiency of training and education** - there are definitely handful of acts and legislation of safety and health in the country. However even after attending induction and training session, the actual understanding of act and regulation among public need to be measured. As generally aware, the statements in law are sentenced in repetitive and elongated formation thus making it confusing for direct comprehension. It will require someone who is well versed in both areas of studies in order to effectively educate and transfer the meaning to the public. Induction to immigrants' workers also is a challenge due to differences in language and communication. The training provided must be specifically relating to process, tools or machinery which the worker will be handling, however since there are countless types and categories of equipment involve in the industry, thus delivering a perfect training session is too much costly.
- b) Economic factor** - as to educating, planning and acquiring Safety & Health personnel are highly expensive, the community normally decides to take their chance with regulation. Even with harsh penalties, people involved in the industry have to succumb to the restriction in financial cost. Taking example of notice issued for 'falls from height' in 2012, the inspector has record the numbers of 240 Improvement Notice, 435 Prohibition Notice, and 361 Written Warning.

- c) Development in technology and construction procurement** - improvement and changes in technologies, building components and procurement is also affecting the whole safety requirements. The risk occurred as operator and installer need to familiarise themselves with the changes in the system applied. Changing in innovation means there is an implication of creating another set of law regulating it which is time-consuming while there could be people exposed to the risk.
- d) Lack of safe building materials** – the availability of innovation for less hazardous building materials also plays an important role towards the issue. The content of asbestos which is harmful to human health is used widely for ceilings, brick or block mortar, fireproofing materials, floor tiles, pipe coverings and many more. Preventing its usage legally is just not practical if the industry is not provided with alternatives to substitutes these materials. Whilst the global concern towards sustainability did expand, it will take only gigantic corporation with huge capital investment to produce new materials in the market.
- e) Unpredictable weather and natural disaster** – the innovation and technological advancement in weather forecasting do not warrant an exact prediction.

## 6. CONCLUSIONS

This study provides another perspective related to issues whilst assist all significant parties in improvement of the existing health and safety measures performance. There already too many tools laid on the table, thus emphasizing the invisible challenges could minimize the obstructions in achieving the national objective. However, as human being that controls pen and paper, governing assortments of individuals and organizations in the market is just like painting an abstract; some may actually see the beauty on the canvas while some just simply see shapeless scratches.

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