

**A COMPARISON STUDY OF OCCUPATIONAL
HEALTH AND SAFETY PRACTICES AMONG
PERMANENT AND OUTSOURCED CONTRACT
EMPLOYEES IN CONSTRUCTION SITES**

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ABSTRACT

The accidents frequency in construction field is relatively high in Sri Lanka. Construction industry is one of the significant sectors that need an effective and fast site safety practices. The most suffered category is outsourced labours in labour market as the permanent workers in this field are protected by law and their employers provide reasonable protection to them. Accidents are happened mainly unsafe condition and unsafe behaviors of the workers. In most occasions accident happened not only one reason but combination of other factors too. To increase the safety of the construction field real root causes must be identified. At the beginning reviewed past literature relevant to this issue. Then reported accidents and other information from twelve construction sites around the country were collected and investigated to find causes of accidents. Questionnaire forms and interviews were carried out to collect information both outsource contractors and permanent workers. Separate questionnaire form was prepared for the supervisors working in the construction industry. The results of this study says that accidents are the causes of many hidden factors. They are unsafe method, unsafe human behaviors, unsafe or inferior quality equipment, bad site conditions, poor Occupational Health and Safety (OHS) knowledge, ineffective supervision, poor safety culture. The causes of accidents in Sri Lanka were also very similar while reviewing past literature of the world. Finally it was revealed that main causes to accidents in construction industry are the workers' risk taking behaviors, unable to follow safe work procedures, working at elevated area without proper precautions, unsafe electricity equipment and use them unsafely etc. In addition, work without proper training not using suitable and sufficient safety gear are other causes. The purpose of this study to take immediate actions by relevant managers in such industries in Sri Lanka to get rid of those issues to make their work sites safe and increases the productivity.

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List of Abbreviation

OHS	-Occupational Health and Safety
EU	-European Union
PPE	- Personal Protective Equipment
ILO	- International Labor Organization
HSE	-Health and Safety Executive
HSW	- Health and Safety at Work
OHSA	- Occupational Safety and Health Administration
GVA	-Gross Value Added.
BERR	-Department for Business, Enterprise and Regulatory Reform
CIRIA	- Construction Industry Research and Information Association
GDP	-Gross Domestic Product
GNP	- Gross National Product
CDC	-Centers for Disease Control and Prevention
ADSI	-Accidents death and suicides in India
CDM	-Construction, Design and Management
USBLS	- United States Bureau of Labor Statistic
HBV	-Hepatitis B virus
HCV	-Hepatitis c virus
HIV	-Human Immunodeficiency Virus

CHAPTER 1

1 INTRODUCTION

1.1 Background

Construction industry is one of the most hazardous activities involved process (Nenonen, 2011). The single most valuable asset in any organization is human resources and hence, ensuring safety of employees from hazards in the occupational environment is important. Past accident records show that incident rates are high within third party (outsourced) workers when comparing to permanent employees in the same work site. Incident will be an event that happened while on duty which will be an injury or work related ill health condition or may be a cytotoxic event (OHSAS 18001 2007)

Outsourced activity means (Leighton, et al., 2007) get performed some kind of jobs by outside party instead of doing those job by host company. In this concept the outsourced work could be get done by individual person or reputed company. This is a famous human resource management concept over the world in present

Outsourcing is also defined as having work activity carried by some external party within the host organization. (Beaumont and Sohal, 2004).

Outsourcing is used by most companies to decrease costs by removing some critical tasks to external body instead of having done it by host company This is very cost reduction strategy if it managed properly.

The main reason for high accident rates among outsourced workers is unable to identify potential job hazards in work environment. A job related hazard could be defined a situation that may create serious consequences to people either ill health or physical injury or both.(OHSAS 18001 2007). This may be an unsafe condition or unsafe behaviour of workers and the perception of hazard is important. A hazardous source is the background condition which will not cause danger itself, but may give rise to an accident. The hazardous activities among construction industry are but not limited to, working at height, heavy machinery operation electrical energy usage, work on confined space, involving work with heat, heavy noise and dust etc. With

possessing those hazards in construction industry may cause serious accidents unless sound and strong measures are taken to prevent them. The full time permanent employees and third-party outsourcing employees are main two work groups involving in construction industry. The permanent employees are considerably aware of Occupational Health and safety (OHS) matters of the organization whereas the outsourcing employees are less aware of safety conscious and may face more accidents

Document presented to the European Parliament by Committee on Employment and Social Affairs –August 2011 mentioned that contract workers basically engage unsafe activities and poor health conditions while on duty as industries normally outsourced critical tasks. Majority of outsourced workers compelled to work in more critical conditions in the work places . These critical conditions may be shift works ,night work ,long hours ,bad ergonomic risk situation and some discrepancies while comparing full time workers. The time they involved in the critical task will depend to having work related illnesses and deceases. The pathetic issues is that some potential health problems will create after they left the company and difficult to get some compensation from the host company. On the other hand they are not entitle to company paid bones, company arranged training and awareness or promotions. Ultimate result of those issues will be a psychosocial problem and make them more stress frustration, depression. When considering above bad issues the outsourced workers face high level of accidents.. (Occupational health and safety risks for the most vulnerable workers EU 2011).

However, some common factors which have attributed to these incidents, these will be:

- An absence of suitable and sufficient risk assessment and/or defined safe method statement of work to perform hazardous activities.
- High tolerance for risk taking behaviour. Meaning there is an acceptance of known hazardous conditions and practices.
- It is very difficult in obtaining competent contract workers with suitable and reliable equipment.

- Inadequate supervision and monitoring of work during the task- allowing unsafe practices and conditions to exist

The issue of managing less aware OHS of the workers is an ongoing concern among organizations of all industries in Sri Lanka. Typically works carried out by these workers are not directly supervised by an OHS manager or any manager of the host organization.

In present outsourcing is cost effective phenomena for Sri Lanka not only in the private sector but also government service too. But it is still doubt to many countries that outsourcing will continuously beneficial and the potion of cost reduction to their governments (Pollitt and Bouckaert 2004).Now this issue is more critical as outsourcing is not only focus to simple tasks such as security waste management and welfare jobs etc. but also hand over more core jobs in the industry .

1.2 Research gap and problem statement

If the organizations, prefer to be more productivity flexible and effectiveness, in recruiting employees ,the outsourcing increasing at the same time of organizations (Mitlacher, 2007; Slattery, Selvarajan, & Anderson, 2006). When considering China employment statistic nearly 37 million outsourced workers are employed from outsourcing. but performing work in client companies, contributing for 13.70% of China's nearly 300 million employees in urban areas (Lin, 2013). In China the outsource ownership vary to various forms. They may be Government controlled companies , foreign-owned agencies and local corporations in China.In this country outsource spread to various industries in present . As third party outsource workers do their task more effectively and flexibility, the companies possess more effective management (Zhang et al., 2014).When considering the work done by outsourced workers and permanent workers the outsource workers involved in precarious tasks and the relationship between the host company is very low. This situation cause outsourced workers more stress helplessness and discrimination . The low level of recognizing is the critical attitude and behavioral issues to the outsourced workers (De Cuyper & De Witte, 2008). Majority of outsourced workers think heir organization pay low attention to them. On other hand they have limited oppotunites

to discuss with their own management of their issues and also less opportunity to contact host company management too.(Pfeffer & Baron, 1986). In this concept the critical issues is to understand the outsourced workers' organizational culture as it is directly influence employees health and safety issues (Cappelli & Keller, 2013),and out put of the workers (George & Chattopadhyay, 2005), specially turnover or remain in the service (Galup, et al., 2008), outstanding behaviors (Grojean, et al., 2006).It should analyses, the way that outsource workers create the relationship with host companies . When analysis evidence on employees' identification they are mostly focus to permanent employees. But western countries this is most researchers target on outsource workers' (e.g., the United States, European, and Australia) (Hall, 2006; Nienhüser & Matiaske, 2006). Therefore this research has focused to conduct reasonable evaluation of the relationship of contract workers and their company in Sri Lanka. This research is focused on to assess the vulnerability of outsourced workers compare permanent workers work related accidents.

Available literature shows specially outsource workers are more susceptible for accidents than permanent workers due to harsh conditions and poor health conditions. (BERR, 2007, DTI, 2006, Taylor, 2007). Therefore, analysis and determination of root causes are important for minimizing such accidents. In this study, an attempt has been made to evaluate the risk of potential and actual injuries at construction industry in Sri Lanka while outsourcing third party contract workers. This study will be conducted and directed towards quantifying previous accident data, the competency levels of both contract owners and contract workers, the training and experience of workers, the quality and suitability of their tools equipment etc

Aim and objectives

Aims

Compare OHS practices between outsourced and permanent employees in the construction industry thereby enhance the health and safety conditions of the outsourced employees

Intendant objectives

Objective 01:

To identify common unsafe behaviours of permanent and outsourced contractors in construction industry

Objective 02:

To analyze unsafe behaviours and other hazardous factors among permanent and outsourced employees in the construction industry in Sri Lanka

Objective 03:

To analyses the applicability of global practices to minimize unsafe behaviors among outsourced employees in Sri Lanka

CHAPTER 2

2 LITERATURE REVIEW

2.1 Introduction

This chapter describes literature on outsource employees and their contribution in the construction industry. Also this chapter includes findings of OHS practices of issues related to outsource employees and the global scenario

The literature review will enable a context for the research, show where the research fits into the present knowledge, provide an opportunity to learn from previous theory on the subject, discuss how the subject has been studied previously, highlight gaps in previous research, and finally it helps refine, As this dissertation focuses on outsourcing workers on construction site, the advantages and disadvantages should be identified

2.1.1 What are the Advantages of Outsourcing?

- When outsourcing non-core activities like cleaning security, transport etc. the company could more attention on core functions
- Cost saving is the vulnerable advantage to the organizations. Labor cost and operation cost may have minimized and also reduction of over head cost is the make positive impact
- The outsource concept will help to reduce controlling problems of some function

So the outsource will increase productivity and efficiency ,then organizations will be more strong and successful , ready to take market challengers will have better cash flow

2.1.2 What are the disadvantages in Outsourcing?

But the major problem of outsource concept is high accident , incidents and ill-health due to unskilled untrained and incompetency workers. Also following issues also encountered with outsourcing (Mayhew, 1997).

- Resource losses due the lack of ownership
- Losing control people as they do not take clear responsibility
- Problems with quality of the output as well as the time factor
- Normally outsourcing owners may provide their service to may organization and they are not in the position to pay their total attention a single company. So ultimate result will negatively affect to the work out puts and unnecessary delays and poor accuracy of the works
- Some indirect expenditures like incident investigation cost and other indirect cost like legal expenses will be increased as the accidents will increasing in outsourcing

There are many benefits to permanent employees over outsource employees as mentioned below:

Insurance

The significant advantages to permanent employment is company provide insurance benefits. This Insurance coverage will cover but not limited to occupational health ,vision, life, dental issues and bad consequences of accidents and incidents

Vacation, Holiday and Sick Pay

Permanent workers entitle to vacation leaves, sick payment ,holiday payment ,welfare facilities in most companies but outsourced workers do not entitle to those benefits

Permanent employees normally get higher paid on vacation ,sick and holiday whereas outsource workers will not be able to such percentage. Because entitle vaction time also calculate to total work hours

Retirement

The full time employees getting retirement benefits whereas majority of outsourced workers are not entitle to get such pension payment or employees not arrange any kind of financial fund benefits of them

Job Advancement

Most negative news is no guarantee that outsourced workers getting any job advancement ,not recognized financially or mentally for their best practices ,nor minimum welfare facilities while the fulltime employees getting those benefits

Job security

Even your performance is poor or not up to the required level. Company cannot dismiss an employee who is protected by the Government law. Hence certain jobs are more secure than outsourced employment.

Training and development opportunities

Most organizations analyze training needs according to their employees and prepare training and development annual plan. Employees working in those organization have more opportunities to develop but outsource workers do not have such opportunities

Proper equipment

In general, reputed company purchases standard tool and equipment with reliable safety provisions. Most occasions outsourced workers do not have standard equipment and suffer accidents due to lack of such safe tool and equipment

Quality Personal Protective Equipment (PPE) and other benefits

PPE is use as last resort of accident prevention in industry. To have better protection the PPE should be suitable and sufficient, but PPE used by outsource workers are inferior quality and do not provide intended protection

Number of deaths due to occupational accidents illnesses in industrial countries in Europe and other western countries is 5-7% when comparing total deaths. The International Labor Organization (ILO)report highlights nearly 2 million fatal and 268 million other occupational accidents occur annually (office,2003).Further the International Labor Organization stress that 4% of the annual global gross domestic product contribute to production losses, absenteeism, medical treatments and compensation payments to injured employees in the organizations (Takala, 2014).These information shows that occupational related incidents and ill-health problems make serious impact in the industries (Fernandez Muniz, 2012) and (Ramli, 2011)

2.1.3 OHS and construction accidents

When OHS is concern health refers preventing human bodies and their minds from illnesses due to process of production, manufacturing, material being used in work places on the other hand protection employees from body injuries is refers as safety (Holmes, 1999).According conclusion of the European Foundation for the Improvement of Living and Working Conditions, 1991 ,reason to the accidents in construction sites around 60% due to decision made by top management from the work sites

OHS management concept should consist both preventive and corrective actions needed to continuously uplift the safe conditions in work places (Works, 2006) and (Oedewald, 2006).In general Construction work environment is continuously changing and more complex. So these construction work sites are more dangerous

(Carter, 2006), but introducing safe work behaviors ,practices among workers majority of prevailing risks could be eliminated

Occupational Health and Safety (OHS) laws regulations and standards are originated on how the risks associated with working conditions be managed using technical approach (Holmes, 1999) ineffective safety standards and regulations and poor enforcement methods cause to serious accidents to the workers (Watterson, 2007).

Health and Safety Executive (HSE, 2003) defined accident as any unplanned event that results in injury or ill health to people, or damage caused or loss to resources , equipment, materials or the ecological or a loss of a business opportunity

According to the National Institute of Occupational Safety and Health Act, No. 38 of 2009, the Health and Safety Executive (HSE) has responsibility to enforcing in Sri Lanka the Health and Safety at Work (HSW) Act and in performing general day-to-day activities to enable the National Institute of Occupational Safety and Health to perform its key responsibilities .The numbers of accidents reported by employers in srilanka was 392 during the period from 2012-10-01 to 2013-09-30. according to the recent statistics of the Labour Department. But while analyzing accident report of the same period of the Accident and Orthopedic Service of the National Hospital of Sri Lanka they have treated 11,047 patients whereas the total of 105,217 patients who have met occupational injuries. According to this information the employees have reported accidents only 3.5% ,but actual percentage is 10.5% (Darshana, 2017).

So due to these reports contradiction concludes that no effective way to obtain correct information of accidents by authorized bodies in Srilanka. Other important thing is during the same period only 1970 occupational hazards related accidents were investigated

2.2 Main safety issues in the Construction industry

Safety of the people is very important and it is not a separate issue from a manufacturing activities which are always involves people. Occupational health and safety related accidents only impact company as financial losses , but serious consequence is death of workers, suffers their closed family members their friends.

When considering long term effect it is loss for the company too . This not common to in Sri Lanka it effect other countries in the world in same way .

Generally reasons to high frequency of accidents in work sites could be identified as unplaced start of activities changing work location frequently, working in unsafe open space, bad working conditions, experience bad weather conditions, target time frame and unachievable schedule, work require high physical endurance, as well as incompetency and untrained workers and poor safety culture . The OHS management and OHS protection system are in place due to the causes of high work accidents in construction industry.

The other main problem is poor reporting of accidents and non- reporting of accidents or not really identifying the real root cause.

According to the Occupational Safety and Health Administration (OSHA) research study the information of accident due to not follow isolation and lockout procedure is incorrect because those accidents are rarely reported or reported under other categories(like electrical incident, poor machine guarding ,burns equipment malfunctioning etc.) .This is more common to lockout tagout related incidents,

OSHA identified this issue as underreporting accidents or either intentionally not reported or negligence of accident reporting. With this result OSHA things available date on injuries and fatalities is only a part of the total incidents and accidents really took place However OSHA trusts that the accidents which were reported , investigated studies under lockout tag out exhibit a graphic illustration of the severity of the problem ,the common related factors ,how it extend in work industries and the severity level of those accidents.

Manufacturing and Construction activities are not equal, and they have different features. These features could be identified from qualification of employees, quality concepts, procurement strategies of services and goods ,method using wear hoses and go-downs . Specially in construction projects safety and health considers as major issue and failure to manage safety and health in construction field will cause serious consequences

Occupational safety and health administrator-Department of Labor United State report mentions that construction site worker injuries, illnesses and fatalities in 2014 workplace fatality preliminary data reveals that 4,679 outsourced workers fatally injured while on duty in 2014 – This mean at least 90 workers per week or 13 workers per day loss their life. The construction related deaths is 17% of total work related fatalities in 2014

In 2014 work related deaths of private industry was 4251 whereas as 874 (20.5%) were reported from construction projects . This mean every five work related deaths, one is from construction industry in 2014.The main causes to fatal accidents in construction project were fall from elevated areas, electrical shocks ,struck with falling or flying objects ,caught or trapped to unguarded drives due to poor machine guarding The above main four reasons contributed for approximately half (58.1)of the deaths in construction field in year 2014.

Fall from elevated areas - 349 (Total 874 deaths in construction in 2014 (39.9%)

Death due to electricity — 74 (8.5%)

Struck by falling or flying objects — 73 (8.4%)

Poor machine guarding — 12 (1.4%)

(Occupational safety and health administrator-Department of Labour United State, 2014)

2.3 OHS Implementation process of construction industry

The execution of construction activities is commonly identified as several steps. The steps are practicability phase, design phase, execution phase, and operation phase. The execution phase is the most critical to work accidents because in this phase the

majority of resources are used, and they interact with each other, ultimate result may more risk of work accidents.

The critical issues in construction field comprise expenses , period of project , quality, safety and health, and other environment issues .Identifying and controlling hazards related risks in construction field is the responsibility of project management by utilizing the available resources. Proper planning, effective operation, proper management, and positive and reliable control are performed in integrated manner considering the five risks existing in supply chain to fulfil the objectives of the project, focusing zero harm to the workers .

Work related accidents in construction projects will cause serious consequences, demotivate workers, activities disturbances , barriers to the completion of the project within the acceptable time period and cost incurred in general. Accident Rate of construction sites badly influences the overall project expenditures including safety and health related expenses too. With considering these issues accidents rate should be minimized. But the consequence of accidents impact not to be identified as a competency problem of contractors because it could badly effect to proper execution of the project .

Occupational health and safety related accidents could happen due to two main factors such as unsafe conditions and unsafe behaviors of the workers. A main reason to behave unsafely is due to the insufficient knowledge and experiences of the employees who tend to neglect safety rules and regulations, as also no demonstrated management commitment.

Employees in construction projects are prone to behave unsafely. The main target of this research is to identify the reason for high accidents rates in construction field. Gathering proper information on workers age levels, their knowledge and experience and real work environment they are working, and also conducting interviews with workers are major steps to complete this research.

In general most construction work related issues may bring negative impacts. While studying a few past constructions project reports, followings are cited as a few impacts due to accidents (Rafiq and Fang, 2008).

(1) Workers may get negative consequences such as, pain of his body or part of organs , partially disablement ,total disablement, and death;

(2) Negative effect to project activities, preventing the proper execution of the project, project completion time delays, or suspension or totally termination of the project, and budget expenditures exceeding while project completion.

(3). The expenses identified is the one not think in accident insurance, namely cost incurred to work related accidents and cost incurred to delays in project activity (Johnstone et al., 2000).

2.3.1 OHS issues in construction industry

2.3.1.1 United Kingdom

The BERR (Department for Business, Enterprise and Regulatory Reform, formerly Department of Trade and Industry).identified that construction field is one most economic sector in United Kingdom where 250,000 companies put into work more than two million employees and contribute 8.2 per cent of GVA (Gross Value Added). Construction industry is a more complex, dynamic and challenging field. It intercalate a series of resources related to civil works and out puts , customers , and relevant operating producers, services creators, suppliers and erectors , contractors both main and sub , competent officers in the field , and reconstitute the services. An immense type of project and enterprise sizes are came in to play, distributed from multi-nationals to small and medium companies and individual contractors . Particular construction project may be a combination of companies performing their work under main contract and sub-contract to a main contractor. Work force in an single company may consist with only their own workers, only sub-contractors or be a combination of both (Taylor, 2007).

When considering construction work force it consist with both permanent workers and contract workers. In large work force English knowledge is not an issue them to communicate.. In early decades specially outsourced workers recognized as working in more harsh condition and poor work environment, poor wages and critical hazard condition. In the meantime, they were unnecessary pressure if they are not in the work schedule time. This pressure may happen due to lack skill and competency of the

workers. The forecasted requirement of new skilled workers to construction industry for year 2011 may be 87,600 .If not pay positive approach to construction sector it may be a serious accident ,incident and ill-health ground due to those various factors (BERR, 2007, DTI, 2006, Taylor, 2007).

In the Construction Summit of 2001 industries confirmed to reduce to fatal accident rate by 40% during 2004 and 2005 and 60% reduction in 2009 . In other hand HSE made public service agreement with the target of reduction of accidents by 3% during 2004 and. The period of 2005-2006, a considerable low fatal injury rate reported, although, more lately John Spanswick, HSC commissioner, highlighted a concerning 34% death increase during 2006- 2007 when considering previous year (Construction News, 2007).When considering causes to said fatal incidents remain expressive ,and causes may unsafe acts and poor safety culture and no proper attention paid (Sherratt, 2014). Some cases were not supervisors at the incident scene, poor hazard identification and risk assessment, no proper physical and human resources available at the work sites and also the cultural and organizational issues may contribute safety behaviors of the workers (Construction News, 2007)

Improvement of knowledge of the work force is critical need to cultural changers and it was highlighted by ‘Respect for people’ curtailing from the reports of the ‘Strategic Forum for Construction’ (the so-called Ethan reports) ‘Rethinking Construction’ (1998) and ‘Accelerating Change’ (2003). The Construction Industry Research and Information Association (CIRIA) has also searched to identify the people related factors that hinders the change in the construction industry - ‘It’s a people thing; more practical aspects for rapid change’ (CIRIA, 2003). Similarly, at the 2005 occupational Health and Safety Summit in Construction, the Industry Strategic Forum itself confirmed the ‘Respect for People Code of Good Working Health and Safety Practices’. Most critical leading issues in this Code of Practice is Behavioural Change and Worker Engagement practices within the construction sector (Health and Safety Laboratory for the Health and Safety Executive, 2008)

Close monitoring of such research, following causes are identified as major causes of accident to outsource workers

- Supervisors non presence at sites,
- Risk assessments are inadequate to mitigate the risk.
- Not sufficient resources available for performing tasks,
- Implying problems residing at a cultural or organizational level that can affect safety behaviors

2.3.1.2 South Korea

In here briefly discuss a study in the construction industry of South Korea related to issue of deaths and injuries in work site. The industrial accident statistics of the years 1991–1994 were extracted from the annual publications of the Ministry of Labour. The above periods were analyzed considering the size of company, age of injured person, experience and knowledge in relevant task, accident category, injury category, part of body the injured, and agency of accident. The outputs illustrate that there are some patterns in the features of occupational injuries of construction industry:

- (1) Deaths occur more frequently in older workers;
- (2) The utmost type of accident is ‘falling from height’;
- (3) ‘Fracture’ is the leading injury type;
- (4) The most critical part to injury are the leg, foot and toe in lost time injuries, but it was changed in fatal injuries and the affected areas are head, face, and neck .
- (5) Majority of accidents reported from outsource workers at construction industry

The results highlighted the difference concerns of fatal accidents and lost time injuries. These results and findings of this study could be used in accident prevention strategy (Jeong, 1998)

2.3.1.3 Hong Kong

The safety culture in construction field is more important as this industry is more prone to decentralize and dynamic. A safety culture related questionnaire was made and conducted a survey in Hong Kong covering majority of work sites and leading construction agencies with their contract workers. This survey identified 4179 incidents and these incident were reported from 54 sites. During the factors analyzing

process a 15- factor frame-work that explain the scope of the safety situation has been extracted, When investigating past research papers the behaviors issues , consequences of activities of co-workers and OHS inputs of the safety culture are highlighted. The existing information confirmed the possibility of inquiring common issues of the safety climate in the construction field .When the issues were exploring further logistic regression was used to explain the connection with safety culture and individual issues. Clear relationship was found safety climate and individual behaviors. The gender deference, marital status, and education level, number of family members to support, OHS awareness , drinking habits, direct employer, and individual safety behavior identified as key issues. This is a case study and the collected data confined to one organization , but the research methodology may be very useful for future researches On the other hand collected date will be more important to construction engineers ,managers and safety personnel in current construction projects to develop their safety climate (Choudhry and Fang, 2008)..

Identifying behavioral safety factors

While exploring past OHS researches and case studies numerous issues could be identified as contributing factors to unsafe behaviors

Alcohol and Drugs

Using the audit test accepted by safety professionals , a study (Biggs & Williamson, 2012) of nearly 500 outsource workers in Australia deemed 286 (58%) were above the cut off score (8) for critical alcoholic consumption. This issue is unfair to be just target to Australia, globally drinking habits are considered: various areas of Europe, also in the UK, drink more alcohol than Australia (World Drug Report, 2012).). Drug takers are commonly considered as high-risk takers and most probably they are aware of the risks (e.g. heart attacks, addiction etc.) but the neglecting the negative results . So if the workers are working with influence of alcohol and drug are willing to take risk on site.

Experience and Training

When considering accidents among workers, their experience and training are strongly linked together. Well experience and competent workers rarely expose to hazards than inexperienced and incompetent employees (Laukkanen, 1999), When human experiences and competency influence safe or unsafe behavior on work environment and also linked to OHS management systems (Fang et al., 2004). Most important finding was more than half of all accidents on site occur within the victim's first week (Stokdyk, 1994). This indicates that safety induction and work-related safety awareness are very essential to safety behavior development of new commers

Management

The top management of the organization could control incidents while introducing behavioral-based management systems. Availability of such initiatives are very useful as 80% to 90% of accidents take place by unsafe acts of the workers (Lingard & Rowlinson, 2005) and other separate study reveals that how to manage risk was a factor in 84% of accidents (Haslam et al., 2005). Unacceptable acts are done by individual and it could be controlled by management of the organization (Lingard & Rowlinson, 2005). Positive results are available that behavioral-based safety is play a vital role on productivity of the organizations too (Lingard & Rowlinson, 1997), 1997).

Cultural issues

Other vulnerable finding is that culture exists (Ankrah, 2007). Hofstede's (1983) cultural facts and concept influence on a society's culture and that society members' values and how they acts while facing these values. However management level people considered that behavioral issues are more important at work place than their own general culture (Mearns & Yule, 2009)..

Risk Perception

In generally a huge gap is in hazard identification and risk evaluation of construction workers when considering an acceptable level (Carter & Smith, 2006). When analyzing it is revealed that the workers are unable to identify the risk in proper way

so able to respond effectively. The way they recognize risk makes them difficult to distinguish the real causes and underlying cause consequences and unable to take effective risk mitigating measures for risk-taking behavior (Haines et al., 2004).

Risk Taking and Thrill Seeking

Risk acceptance for purpose of thrill risk taking have a remarkable relation (Zuckerman, 1994). The people who are seeking thrill accept risks in most occasions only for the thrilling but no other valuable reason. The workers scored considerable level on the Zuckerman's sensation seeking scale (Zuckerman, 1994), a acceptable psychometric test, proved that connected to higher accident frequencies (Bierness and Simpson, 1988).

Shift work and stress

.Shift works changes the sleeping pattern and makes work stress among shift workers, which may uplift the probability of accident occurring. Use of alcohol or drugs has a relationship with them, A working shift pattern will change their clocks phase and holidays of them. But one research (Holland & Hinze, 2000) specified that no statistical evidence to prove accident rates and clock phase make adverse effect. But other study (Barnes & Wagner, 2009) proved that shift employees had suffered with 40 minutes less sleep, faced 6% incidents and unable to work 68% more working days, than on other general workers. The results highlighted here were only small injuries between happened in between 1983 and 2006.

Safety Culture

The concept "safety culture" initially came in to play in the 1987 OECD Nuclear Agency Report following the devastating Chernobyl disaster in 1986 (Cox & Flin, 1998). Poor safety culture basically increase accidents, including high profile disasters such as the Kings Cross Fire (ACSNI, 1993). Safety culture could be defined as a subculture of general culture of the company. (Schein, 2004) and it can be run with safety culture (Whittingham, 2012). So this learning is very useful. Also few

researchers were able highlight influence with it. So few other researches should be required to identify its vulnerability.

2.3.2 Construction Accidents in Sri Lanka

The definition of 'Accident' defined by Laney (Laney, 1982) as "an uncontrollable occurrence which the consequences of injuries or damages". Another definition that used popularity is "an unplanned not necessarily injurious or damaging event that interrupts or disrupts the completion of an activity" (Laufer & Ledbetter, 1997). OHS statistics in construction field is very poor while comparing other industries in industrial world (Hinze & Appelgate, 1991; Davis and Tomasin, 1990) have identified three critical reasons for bad safety records in the construction industry, which are highly inflamed high rate of accidents. They are:

1. They exist very short period and its dynamic nature.
2. Not effective work environment controlling and
3. They are most probably complex and changing nature within the industry

Construction reacted accident is considerable I high level with respect to other industries in Sri Lankan. When analyzing records of accidents 53% of fatal accidents recorded from construction industry but relatively small percentage (6%) of fatal accidents

(Annual Report labor department SriLanka, 2014) .In Mining and Quarrying industry the fatal accident rate is high. These accidents relatively more serious than accidents in manufacturing sector ; If nine fatal accidents happen in construction site only one fatal accident happen in other industries during same period of time.

2.3.2.1 Construction industry & GDP growth in Sri Lanka

The construction industry cannot be neglected as it plays a vulnerable role in development of the country. It influence critically the Gross Domestic Product (GDP) and Gross National Product (GNP) of Sri Lanka economy. The sector alone has contributed 6.6% in 2009 to 8.7% in 2013 towards the overall GDP. Therefore, it has influenced a significant impact to the economy of the country (Athukorala, 2015).

GDP from Construction in Sri Lanka raised to 200970 LKR Million in the fourth quarter of 2016 from 157734 LKR Million in the third quarter of 2016. GDP From Construction in Sri Lanka be around 131296.96 LKR Million from 2010 until 2016, reaching an all-time high of 200970 LKR Million in the fourth quarter of 2016 and a low recorded value of 77176 LKR Million in the second quarter of 2010

Table 2.1 Sri Lanka - GDP from Construction

Sri Lanka	Latest	Reference	Previous
GDP	82.32	2015	80.03
GDP From Construction	200970.00LKR Million	Q4 2016	157734.00

The rapid growth of the current projects like such as mega power generation projects, high ways and expressway projects make large opportunities for contraction agencies

The construction industry generates 7 % to employment opportunities in Sri Lanka . whereas as In 2009, nearly 562,000 workers were able to worked in this field .The jobs shared with professionals, technical personnel, craftsmen, and machine 25yeras and 45years. Important issue was among those workers 52 % having less than 5 years of experience in this industry (Jayawardena and Gunawardena 1998).

The construction industry is associated with the following hazards too (except working at higher elevations)

Vehicle and traffic

Isolations and lockout energy

Use of Electricity

Digging and excavation

Without Guarding to moving parts of machinery

Confined space entry

Hot work

Hazard identification and Risk assessment is vital in not only construction industry but also all other industries. Cement manufacturing is no exception too and in this respect several studies with different approaches had been done. Nevertheless hazards and accidents in limestone mining areas is very complex events and many factors could contribute to happen incidents at any time (Sari et al., 2004). As this is a serious problems, different researches were conducted to identify the relationship between the human health and environment conditions via effective parameters in the occurrences of injuries or fatalities not only the limestone quarry but also whole cement manufacturing operation.

New OHS management practices recognize that there is a significant connection among safety and reliability (Cox and Jones,2006). It is suggested that there is a need for an integrated approach to OHS reliability and risk management.

2.3.3 Accidents in Production site

Today a majority of organizations want to achieve safe production. This means production will be done without compromising safety.

Most manufacturing organizations are very much concerned on occupational safety and health of their workers. They maintain world class safety systems to achieve zero harm to their workers. However, there are two types of workers working in the said organizations, they are permanent workers and outsource contractor workers. Permanent employee has good safety culture as they are working continuously to the organization and more familiar with hazards associated with the process. Unfortunately outsource workers have poor safety culture and frequently they are changing. Apart from that they possess.

- Insufficient knowledge of associated hazards

- Incompetency
- Low Education level
- Less experiences etc. (Rafiqand Fang , 2008),

However they involve in very high risk activities in the industry

Apart from normal manufacturing process there are other construction activities frequently carried out around the world. Normally those activities are done by third party contractors.

2.3.4 Accidents in construction site

Accidents continuously take place in construction sites. In 2010, when considering 100 full-time construction employees in the United States' (U.S.) was a four figure number (Bureau of Labor Statistics, 2012). Taking in to account that 5.5 million workers met with an accident during that time , the incident rate tells that 0.22 million workers met accidents while on duty. This figures also highlights 802 fatalities, which may around 17% of accident with fatalities in all industries. In other words, in construction industry in U,S approximately three workers do not return their homes every working day

To prevent or reduce consequences of accidents and develop workplace OHS condition it is important to understand what are the causes of such accidents and their consequences . Recent accident cause identification studies, (Chi, et al., 2009) compared with domino theory while investigating 75,000 present accident reports. According to Heinrich, there are five sequential dominos contributing to a construction accident injury: (1) workers general Culture and their social environment, (2) Human error while on duty , (3) unsafe acts and physical hazards, (4) accident, and (5) injury. These dominos influence one another and create a serious of events resulting to an accident of worker injuries.

Further analyzing, Chi, et al., (2009) explained accident will cause some kind of injuries ,and most probably there are happen due to unsafe act which workers do and unsafe conditions prevailing in the work site which may be mechanical, physical, chemical or any other conditions relevant to their activities. Heinrich et al. (1936) highlighted if the positive involvement of organization these unsafe behaviors and

conditions could be managed effectively. The management involvement may be safety observation tours, giving OHS related training (changing human behavior) and introducing hazard eliminating, engineering controls to correct unsafe conditions (work environment factors)

With above learning, research studies were carried out to analyze the relationship of human behaviors, work place hazard conditions such as environment and mechanical and physical issues in construction accidents. Inset al., (1998) explained the basic step to identify the real root cause which lead to accidents, exploring the four critical fatality elements including fall due to work in elevated areas, struck with moving parts due to poor machine guarding, electrical related injuries and accident due to poor isolation methods. Choudhry and Fang (2008) did a research study to identify the reason that construction workers more prone to involve unsafe act, and conducted workers interviews and able to identify various reasons why workers act unsafely. Finally they understand human factors such as risk taking behavior and lack of safety knowledge, unclear responsibility, carelessness and failure to follow safety rules procedures, and attitudes towards OHS requirement such as not wearing personal protective equipment (PPE), they themselves making unsafe work conditions, a lack of competency or safety training, and workers' unable to identify unsafe conditions during work. Garrett and Teizer (2009) carried out a similar research to identify organizational and supervisory issues, workers mental and physical level which ultimately lead to human error and highlighted the requirement of human behavior issue awareness sessions and emphasizing possibility of incident controls in work sites. Suraji. (2001) emphasizing the complex relationship of factors in accident causation and proposed an incidental accident causation model. They recognized various issues and event related to causes for accident. This include poor planning, ineffective construction operation or control, worst site conditions, unsafe ground conditions, a heavy noisy or crowded environment, and inappropriate operative action. The significance of PPE and safety devices, conducting proper planned inspections, a safe working environment requirement, safety culture, safety awareness, and proper supervision have also been highlighted by many researchers including Sawachaet al. (1999), Haslamet al. (2005), Aksorn and Hadikusumo (2008), Cheng (2010), Risk

assessment studies and accident risk factors could identify into three categories: unsafe workers' behaviors, unsafe working conditions, and exposure to hazardous injury sources.

2.3.5 Domino Theory

Regardless of these achievements, there is limited studies that screening most important links among different risk elements such as unsafe behaviors, physical hazards, and environmental factors that were highlighted as key accident causes by Heinrich (1936); some studies revealed the combination effects among different risk factors on accident causation and injury severity. Firenze's (1978) classifications theory addressed well to this need. Firenze identified accident connection as a system that is a group of interlinking risk components and emphasized a harmony between human, machine, and environment for accident prevention. Instead of considering the environment as being full of risks and the people doing mistakes, he assumed the chance of an accident is low under normal, harmonized circumstances.

The related concepts of Heinrich's (1936) model to get good understand link among unsafe issues reacted to construction field and to identify the real path of accident causing factors according to Domino Theory

2.4 Causes of Construction Injuries

Available information relevant to the Centers for Disease Control and Prevention (US government) the 3.3 million nonfatal injuries and illnesses reported in 2009, statistically more than 9% accident happened to construction workers. Falls due to working at height was 22% of these injuries and illnesses reported from outsourced workers .

The reasons of construction filed injuries are very common and versatile. Most probably these causes could be identified very easily, but some reasons are difficult to detect . Familiarizing with common causes to injuries will make easy us to get rid of them and any injuries you already suffered make us to take prevention measures accordingly . Most common construction project related injuries are mentioned below.

2.4.1 Falls

Falling from height while working at elevated areas is the major category of construction field injury. The workers in construction industry are at risk from falling scaffolding, cranes, roofs, ladders, and other elevated positions. If someone fall down and injured he will be able to file a Workers' Compensation Claim and most probably a personal injury law will take actions against the employer or another party (Fen Chi, 2005).

In construction projects, workers have to work on particularly building roofs, are the most frequent accidents faced by them. Those accidents may lead to death or permanent disablement or serious injuries to the workers. At the same time project owners to face negative consequences such as loss of work days and the industry face damage to their goodwill. Therefore robust accident prevention mechanism is needed ensure health and safety in construction sites . So managers at construction field should , understand the potential events to falling and their factors leading to falling from a height as important input. The fall accident cases were extracted from accident reports provided by ADSI 2012 and Indian statistical report of 2012. The falling risk event areas and their potential active failures leading to fall of accidents are described in those reports .

Falling Objects from height:

In generally construction workers are at risk due to falling objects from elevated areas If not taken proper action to properly secured to tools/bricks on elevated areas or other construction materials that may be fallen down .The consequence will be brain and spinal injuries workers at underneath, even if workers wearing suitable and sufficient safety equipment such as safety helmets.

2.4.2 Equipment Related Accidents

Heavy machinery and other hauling equipment being used on construction sites can make hazard situations and make danger for workers . For example, due to some failures forklift could not work properly and cause accident, a dump truck could roll over unexpectedly, or a nail gun could misfire. If available equipment is defective they will lead injuries, In industry legal aspect is concern there is a legal theory called

"product liability." which says about who's responsible for defective or dangerous products

2.4.3 Back overs and Crushed –Between

Other critical hazard in construction sites is the risk of being run over by large hauling vehicles while reversing in workers moving areas . They are also caused accidents on crushing workers between large vehicles and walls or concrete. These types of accidents will happen due to supervisor negligence, not using pedestrian ways, entering vehicle movement areas without alerting drivers etc.

2.4.4 Fires and Explosions

Construction sites also store flammable liquid, chemicals, solvents etc. and gases. Then there will be risk of fires and explosions due to exposed electrical live wiring, hot work ,smoking habits of the sites. But this is not in high probability than other kind of accidents, these can, however, be catastrophic or result in serious injuries.

2.4.5 Trench or Building Collapses

Another common type of construction injury is work under excavation which may collapses on the workers working in the excavation. Also while demolishing building or constructing new civil structure may be fail unexpectedly causing serious consequences. In such cases the causes of the accident can't be directly identified, but carelessness legal theory of "res ipsa loquitur" may apply and you can still be compensated without proving who was careless or who did mistake .

2.4.6 Repetitive Motion Injuries, Heat Stroke, and Another Overexertion

With high demand of hard-physical activities required for construction work, employees in this industry often have injuries related to overexertion, including:

- Doing safe activity again and again
- Excessive use muscle and joint of hand and leg may damage due to overuse
- Work in high temperature areas may cause heat stress could lead to brain, heart, or kidney damage or death
- Hypothermia or frostbite resulting in the loss of fingers, toes, and parts of the face in cold climates

2.4.7 High Lead Levels

In some work site hazardous metals may be used for some construction purposes. The poor work behaviors can lead to workers exposures to such metals specially Lead (Pb). Outsourced workers represented 16% of high blood Lead level cases in 2002-2008.

2.4.8 Respiratory Diseases

Most workers in construction field died due pneumoconiosis in past. Pneumoconiosis is an occupational disease and it is a chronic dust disease of the lung, most probably in coalmines. The critical pneumoconiosis conditions that construction workers suffer are asbestosis, and Silicosis. If any workers suffer above respiratory conditions, he/she is entitle to claim product liability from the employers

Types of Medical Conditions Caused by Construction Injuries

The injuries and diseases in construction industry identified above can lead to worse medical conditions mentioned below :

- Finger, toe, limb or other body part amputation
- Broken bones or fractures
- Burns injuries due to unexpected fires, explosions, or electrocutions
- Unsafe nails in wooden pieces , sharp tools, machinery, etc. could make Lacerations injuries

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2.5 Benefits of using outsourcing workers in construction industry

When using outsource workers in construction or manufacturing field the company will get economic benefits. This will encourage company owners to use outsource workers specially their non-core activities (Dainty et al., 2001)..Even they have said benefit the negative consequence will be poor safety and health conditions to those workers (Loosemore and Andonakis, 2007; Mayhew and Quinlan, 1997; Yung, 2009).. Due to rapid development of construction/manufacturing industry the outsourcing also increasing and the adverse health and safety level is questionable . So, need effective mechanism to mitigate this situation otherwise it will be a disaster In England with their legal framework ,they are able to improve health and safety at work (Bomel Limited, 2007) In this legal frame work particularly included specific regulation for construction industry (Design and Management) Regulations 2007 (CDM 2007).Also included some mitigation actions to influence to health and safety of outsourcing. As this OHS issues in construction industry is challengeable and adds this issues in article headline such as “One death is too many” (Donaghy, 2009). Inquiry into the Underlying Causes of Construction Fatal Accidents), The contract owners are responsible to go beyond legal requirement and take proactive measures to make safe work environment to prevent adverse OHS issues in outsourced subcontractors. Even though the regulatory requirement prevails the main contractors (i.e. the employers of subcontractors) should ensure the requirement, while identifying the critical areas and focusing wider area to make opportunities available inter organization learnings to outsourced workers. This study mainly focus how organizations could prevent adverse OHS issues of subcontractors while focusing their own OHS system requirement

2.5.1 Issues related to Outsourcing workers and their occupational H&S

During last three decades there is a remarkable growth in nontraditional employment like self-employment some casual works tempory and part-time jobs and contract/subcontract employment.(ILO, 1997; LFS, 2004; Mayhew and Quinlan, 1997).This not only Srilanka it is common for some other countries too.

This kind of employment form due to economic demand prevailing in those countries

Due to some regulatory changes it may create product market uncertainty (Bielenski, 1999; Chiang, 2009).

Several reasons why Subcontracting is practiced

There will be a labor flexibility;

With outsourcing the company is able to meet product market demands;

The company has an opportunity to hand over critical activities to an outside agency;

labor expenditure will be reduced

Tasks to be completed within a given time frame.

Financial risks to be transferred

Labor workers' compensation cost will be reduced .

(Chiang, 2009; ILO, 2001; Mayhew and Quinlan, 1997; Wong and So, 2002).

Other than above reasons following benefits also encourage subcontracting mechanism

The subcontract workers demanding ability for wages and welfare is less

Normally they will not make strikes or similar unrest

Possibility of changing workers for particular task

Even though organization gets economic benefits, outsourcing workers frequently face negative consequences. They do not have bargaining power, they were not paid at time, Poor human resource skills development measures, they do not have job security (Chiang, 2009; ILO, 2001). These workers face adverse effects on occupational health and safety (Chiang, 2009; ILO, 2001). Outsource system is based on a payment-by-results system where payment depends on the amount of task completed rather than the worked period they spent at work site. According to this concept their earning depends on the speed of the completion of the task. Consequently, they are compelled to work

excessive time, involve hard work methods, and compromising safety as it may reduce the amount of work done. (Mayhew and Quinlan, 1997)..

2.5.2 Negative consequences in health and safety issues in Sri Lanka

In Sri Lankan context the above negative consequences are accepted and following disadvantages also identified

- Poor safety culture
- Required training skills and competency not considered.
- Ownership of their work is not considered.
- High turnover
- High accident rate
- More absenteeism

2.5.3 Adverse effects of H&S influence of outsourcing workers

Mayhew (1997) define outsourcing as “the process of transfer the performance of tasks which often affects the employment status of the workers doing the tasks as well as the manner in which those tasks are performed, the structure of control at the workplace and the patterns of regulation”. In some occasions outsource concept in become an integral part of the industry (Eccles, 1981; Lai, 2000) Because there are some work teams who are specialist in particular task and project owners are compelled to outsource such competent groups .

While analyzing past evidence of outsourcing services in several countries the adverse OHS issues is not a new thing. Research by Harrison et al. (1989) High level of fatal incidents reported in Australia in vehicle and traffic sector and agricultural industries due outsourcing of those services. Reports presented by Toscon and Windau (1994) and United States Bureau of Labor Statistic (USBLS) (1995), both in the USA; Blank et al. (1995) in Sweden; and Mayhew et al. (1997) Recent research studies also highlighted that is same as in the construction industry. In several countries such as Spain, Malaysia, Philippines, Poland, Hong Kong, and China, the negative H&S outcomes of outsourcing has been identified in the construction and manufacturing industry (Byrne and van der Meer, 2001; Chiang, 2009; ILO, 2001). Similarly, in the UK construction field outsourcing created adverse OHS outcomes (Ankrah, 2007;

Brace et al., 2009; Donaghy, 2009) those finding clearly asked to take effective measures to address this phenomenon.

The research which have emphasized on the OHS consequences of outsourcing have contributions of its negative effects, the accident resulting factors and regulatory justification measures (Ankrah, 2007; Brace et al., 2009; Donaghy, 2009; Hide et al., 2003; Horbury and Hope, 1999; Manu et al., 2011; Mayhew and Quinlan, 1997). Analyzing above researches it is clear that there were little attention for contractors' safety management measures/ practices on subcontracting (Horbury and Hope, 1999). For instance, Horbury and Hope (1999) based on a review of H&S literature strongly stressed an effective mechanism to manage OHS issues of contract employees by their employer.

Therefore these researches justify the requirement that contractors' should have their own OHS management system for subcontracting. Anyway the identification of the requirement of OHS system for subcontracting activities be an useful organizational learning

2.6 Importance of Human Error in Health and Safety of Construction industry

When safety is concern it is a basic human need. Safety culture in an organization is a base which ensure employees life, and foundation to reduce incidents. But unsafe behavior of employees is critical issue to affect safety culture. The reasons that outsourced workers behave unsafely to be identified, but those reasons are complicated .Some of those reasons will be poor OHS knowledge, no proper management, psychological and physiological issues ,no idea about consequences of their behaviors .Shi Wenwen et al. (2011) stated the below mentioned human factor will reduce sense of safety.

2.6.1 Physiological Factors

“Fatigue and work stress on duty” are contribution factors which make unsafe human behaviors. This could be explain two separate issues, one is the tasks they are involving is not interest, boring, unbearable tension ,deep concentration needed to particular task then the human thinking ability of the brain may appear suppression, So the "fatigue" directly effect to safety perception and decrease the ability of responding safety issues

, which lead to human based mistakes ,The other factor is unbearable work contents make them critical work reacted stress. To improve efficiency of the workers , companies set unrealistic targets , no sufficient rest time, quantitatively over loaded ,qualitative under loaded. As a result, the employees are unrealistic work environment. Until the workers release from such situations, fatigue work relayed human errors cannot removed , This conditions creates low attentions and so on, and basically create work related human mistakes and errors and leads to more serious accidents and incidents

2.6.2 Device qualitative factor

In some occasions the given tasks to the workers may be not match with their capabilities, may not interest to perform. As such they do not adapt to the work with their capabilities before commencing the task. In practical work, workers may be incapable of the job, he is given and make mistakes, which cause accidents. If the task they are performing make ill-health condition due to diseases, workers should avoid such tasks. Apart of that their physical issues, such as physiological and psychological factors should be analyzed, but possible all factors to be consider while considering their tasks . (Shi Wenwen et al, 2012)

2.6.3 Biological clock factor

According to the 1986 annual meeting of the Association of Professional Sleep Societies (Columbus, Ohio, U.S.A., June 15–22, 1986), a panel of scientists was established to analyze human sleep and brain clocks pattern in high frequency of medical and human error issues. In their report it is clearly mentioned that response time influence to accidents base on poor alertness, ineffective concentration, or low reaction time, insufficient sleep. Further stressed in that report, that critical accidents were caused due to poor responding of workers and statistics tells inadequate capacity make effective responses of unsafe situations.

Role of biological clock, workers response time and patters will poor at night than day time, as fatigue and stress dizziness morally occur at night. Then probability of having mistaken is high and easily lead to fatal accidents.

When considering Sri Lanka construction projects, they extend up to mid night and will start following morning. Workers do not have sufficient rest, sleep etc. and may cause accidents. Their rest room may be substandard and not equipped minimum welfare facility. With those issues their physiological and psychological factors are questionable..

2.6.4 Environmental Factors

When workers in noisy environment, poor ventilated areas, inadequate illuminated places, hot environment, and high humidity, exposure to dust, mist, fume etc., may affects different ways to employees' psychology and physiology states, Finally they suffer irritable, critical emotion, fatigue and easy to make errors and causes accidents.

2.6.5 Family environment factors

Heavy financial issues compelled to some older people and children to work in work sites, which will bring psychological stress to them and make their work difficult and lead serious accidents

2.6.6 The factor of poor safety cultural atmosphere

OHS concern decision making culture is relatively low in construction industry. Line mangers do not take it seriously, the decision making pattern is not stronger, safety awareness not given to suitable workers and consequently this climate do not make a safe work atmosphere, as a result, employees' normally think safety is not a critical factor and it will create a poor safety culture within the organization

2.6.7 Enterprise factors

Even though robust OHS regulation in place, the contract owners do not follow the requirement , OHS training not conducted no feedback evaluation system in place not conduct suitable and sufficient risk assessment etc. Due to those issues workers not developed and they couldn't gain necessary skill, safety technical knowledge and safety consciousness.

In Sri Lanka the contract owners want to get work done with minimum cost and try to curtail OHS cost particularly

2.6.8 Staff own factors

Usually workers do not take safety or operational skill training seriously, they don't have clear attitude to hard learning

The authors specified following areas as ineffective Safety OHS Management

- Just exhibit as they are very safety concern they use safety work just as a slogan like “safety First”
- The actual need of company owners is just financial benefits not a good safety culture. While analyzing it is revealed that those agencies do not equipped with systematic safety system of work or present OHS system is not effective and their implementation level is also relatively low
- Safety management style is also poor in these entities. In implementing safety system of work ,the line managers are responsible to make the system live .To take such responsibility they should have sufficient OHS knowledge but present knowledge and commitment is insufficient. Consequently they are unable enhance OHS knowledge and competencies of their subordinates and direct them on safe way of work .
- On the other hand the role of safety management of the organizations is contradictory, workers do not have clear idea to respond of safety aspects.
- The operability of safety management systems in some contracting agents are ineffective due to allocation of human and physical resources .

The final conclusion of the above investigation result tells the workers in manufacturing process make the real causes to human errors.

2.7 Control measures of human error

The real causes to human errors are not same within each organization , In some company safety responsibilities mismatch with existing roles, poor layout of work places unrealistic work time and work loads poor attention to employees' physiological and psychological issues. In figure 2 emphasized that , it should take effective actions to reduce human error to reduce incidents due to human behavior.

2.7.1 Strengthening Staff Safety Knowledge and Skills

Development employee's skill and knowledge is fundamental matter to think them on safety and surety by themselves in their normal activities .

Training and education must be continuous process of an organization. Various training methods are being used to develop safety knowledge and competency needs, in respect to the capacity of various levels, contract owners may take various ways to develop required safety education according the capacity of the workers. During operation training sessions ,workers learn on operational skills and competencies,and the same time they may learn on the reasons that incident happen ,identify the risk of works, get idea on the significant of safety knowledge Education of safety and operation skill is a long-term process cannot be considered separately . Hence it should be trained according to the needs of employees, strengthen the safety awareness.

In Sri Lanka those gaps were identified but the enforcing part is not effectively implemented

2.7.2 Strengthening the Basic Management

The management of an organization could introduce safe work procedures, rewarding workers in safety performance or salary increment to standardized safe production in their organization. Consequence management to be introduced situational basis while focusing that ultimate objective will be strong safety culture among employees

2.7.3 Enhancing Leadership Safety Awareness

Demonstrated commitment and strong leadership is key factor in OHS management system. Unfair decision making process will create the safety culture of the workers and consequently they understand the significant of safety issues . To achieve that target managers should have strong safety knowledge both theory and practical and able to distinguish hazards and risk situation and propose control measures. This is the best way to improve safety and reduce unsafe behaviors among employees as a good role model..

2.7.4 Creating Safe Culture Atmosphere

Enterprises already recognized the requirement of safety production concept and necessity of good safety climate. Also, they consider safety is long term investment

and introduce series of safe production initiatives with the ultimate objective of safety production as a value of employees

2.7.5 Promoting Worker's Enthusiasm

Management of the organizations should pay their attention on employees' psychological activities, analyses training needs and prepare reasonable educational model to make pleasant work place. At the same time the application of safety concepts, safety precautions by the workers to be monitored which is significant part of safety theory,. Continuously psychological state of employees to be accessed and make them focused to work activities in a normal mind set and create emotional stability..

2.7.6 Protect the Health of Employees

Organizations normally take steps to make different body check of the workers to ensure their medical capabilities. The medical test to be arranged according the work performed by workers , and may be tested for blood pressure, heart disease, epilepsy, etc. workers involving in cement manufacturing should undertake respiratory diseases test whereas vehicle drivers should undergo epilepsy test, etc.

2.7.7 Reasonable Design of Workplace to Guarantee the Good Environment

On designing the work places enterprises should follow to Japan's "6S management". "6S management" introduced by Japanese companies' "5S", its contents: sorting, rectified, cleaning, cleaning, quality, safety; its effects: improving efficiency, quality assurance, provide neat and tidy work place while preventing accidents and assuring safety. Construction organizations should customize actual situation, accordingly to the combination "6S management", and make preferable and safe work environment (Shi Wenwen et al 1999)..

2.8 Risk of expose to Biological agents present in Construction industry

In most construction sites use chemicals and produce waste. That waste will be separated into two main categories

Hazardous waste and

Nonhazardous waste.

In the construction industry it could be seen that both category of waste being used. Some hazardous waste associated with bacteria and virus and cause biological hazards.

Rim and Hong Lim (2014) identified biological agents specially two characters which considered as occupational hazards .They are allergenic which generate bioaerosols and other agents cause infectious diseases. These agents will cause respiratory, decease and conjunctivitis, and dermatitis in exposed workers.

These ill health condition due to bacteria, viruses, insects, plants, birds, animals, and humans known as sources of biological hazards. Above mention hazards create adverse health effect. Several classes of bacteria, viruses, fungi, parasites, and prions, can cause infection.

In handling waste and garbage where majority of third party contract workers are involved..

2.8.1 Prevention of biological risk in work sites

Rim and Lim (2014) clearly mention the preventable measures while working in such environment in their research paper as follows:

Having good hygiene and sanitation concepts in the work places , biological risks could be prevented

The uniform approach known as “standard precautions” is being adopted by most countries to reduce the biological risk .This concept apply all situations where workers have risk of exposure to any kind of biological argent, with the ultimate aim of controlling the opportunities of exposure to blood borne diseases transmitted through needle stick accidents or by fluid contact with an open wound, skin, or mucous membranes.

OHS awareness sessions for workers about human hygiene practices should include that effective hand washing practice is more important in preventing diseases. Workers should be educated about using suitable protective clothing and other safety gear and also keep away of the after completion of work .

These suggestions are totally accepted and most of their precautions are implemented in most organizations.

2.8.2 Protection of workers from biological agents in work sites

Protection of workers with exposure to biological hazards must be used in the workplaces.

Enterprises should take readily practicable measures to prevent workers exposing to biological hazards or if it is not practicable control measures to be taken to reduce them up to the acceptable level. These measures will be engineering controls such as contain them avoiding spreading out, use of biologically safe cabinets etc. and some administrative controls such as introducing safe operating procedures, training and awareness close supervision. If those controls are not practicable, introduce personal protective equipment such as safety clothing, gloves, spectacles and suitable respiratory protection equipment. But the available control measures must be full fill the recommended controls by relevant international guidance according to the maximum exposure level (Rim and Lim (2014)

Their control measures are totally accepted but INSEE alternative fuel and raw material section only provide required training and awareness, close supervision; providing personal protective equipment such as protective clothing, full face mask gloves, and spectacles. No engineering controls implemented.

Alternative fuel and raw material personal should have such training as they are very important aspect of their health and safety. Employers should arrange infection control training to their workers and inform any modifiable diseases prevails in the work site immediately. The most effective mode to prevent infection disease among workers is avoid them direct contact with biological agents, vaccinate workers during required time period and implement effective post exposure procedures.

Also the work behaviors of the workers also effect the prevention of biological diseases. Most significant action will be the availability of practical measures to preventing exposure of those agents which will enhance safety and health of the work team

To achieve this level workers need to wear suitable and sufficient personal protective equipment and keep their wounds if any and practice good health habits such as wash their hand after each exposure during work

2.9 Human factors related to accidents on outsource contractors

Based on the analysis of cement industry following human factors (contract workers) affect to accidents

- Workers age
- Experience
- Job dissatisfaction
- Job uncertainty
- Under paid

Job overload etc

Literature review for each variable used in this study and their hypothesized relationship with work injury are described below.

2.9.1 Age

In private sector in Sri Lanka the retirement age is 55 years whereas in public sector it is 60 years. So people retired from private sector will seek jobs in contract basis. Also the school leavers normally start their carrier from private sector. So there are two major categories of workers working in contract basis they are workers who are above 55 years and others most probably teenagers. It is believed that as aged persons with their higher experience they are able to identify potential hazards associated with their task which led them to be fewer accidents, but on the other hand due to their age they may easily become fatigue and other possible sensory impairment placed them into accidents even they perceive the situation fully.

According to the monthly labor review March 1981 by Norman Root (division chief in the Office of Occupational Safety and Health Statistics, Bureau of Labor Statistics USA).

There are numerous inconsistent explanations of the relationship between employees age and the incident rate of them while on duty . Some analyzes emphasized that there

are no considerable link between age and accidents . In some studies proved that a considerable incidents happened to both younger and older groups of workers when comparing with the middle age groups. Two other researchers make contradiction against the previous finding that middle age groups, those age 28-47, had the highest accident frequency . But few other researches determined that accident rate reduced remain unaltered with age for workers older than 25.

While analyzing those surveys it is clear that study of identify the relationship between the age of workers and accident rate ended up without fixed conclusions (Laflamme & Menckel, 1995). Some studies found that among younger workers (Lin, Chen, & Luo, 2008) accident rate is high, while others have stressed the accident rate is high among older workers (Chang-Cheng et al., 2007). The fair conclusion was the greatest number of accidents occurs in either the younger or older workers.

These contradictory interpretations of the connection between work injury and age have been augmented by equally inconsistent reasoning. Elderly workers have lower accident rates because they are well-experienced, mature, and are well aware of workplace hazards; contrariwise, older workers have significant accident rates because of growing negligence in the workplace-familiarity breeds contempt-and declining reflexes, hearing, and vision. On the other hand, younger workers have higher accident rates because they are irresponsible, less aware of workplace hazards, and have the critical jobs to perform ; by contrast, younger workers have less accident rates because of superior realize and prevent exposure to the more dangerous jobs which are requiring greater experience.

Based on data collected in the Bureau of Labor Statistics Supplementary Data System (SDS), this article analyzes information from more than a million workers compensation records from agencies in 30 States that took part in the SDS program during 1977.

The data clearly tells that occupational rate is lower while comparing to older workers than to younger workers . It seems that the rate of occupational injuries reduces uniformly till age 64 and considerable drop could be seen for workers age 65 and over. The data show the encouraging effect of experience in preventing injuries and

should inspire training for new workers, to decline of the injuries happening in the workplace. –

Nevertheless, older workers may get hurt, and although in most instances their injuries basically replicate workplace hazards which are common to all,

That information is acceptable when considering past accident records of three major projects done by multinational company in Sri Lanka

Table 2.2 Accident records of different working conditions and age of victims

No	Year-Project Name	Outsourced Workers	Permanent Workers	Below 25	26-40	41-55	Above 55
1	2002-Coal mill	9	0	3	2	3	1
2	2004-Roler press	10	0	2	5	3	0
3	2008-dust reduction	8	0	4	1	2	1
4	2012-Roler Press	6	0	0	3	2	1

Source: accident reports of major projects in multinational cement company in Sri Lanka

2.9.2 Experience

More studies were done on workers experience and incidents rate even contradiction results exist. In general work experience is known as the period that particular worker

engaged that task. This experience to be calculated according to the tasks he involved such as construction field, manufacturing field etc. Work experience accident rate has positive relationship. (Hansen, 1989). High experienced workers normally allocated to jobs which need higher competency, good skill, and they should be able to take responsibility of the high risk activities. (Iverson and Erwin, 1997). When considering the experienced workers they may be familiar with hazards and due to their hazard perception will make negative relationship with accidents. Theodore Barry and Associates (1972) carry out a study on cement industry job experience and total other work experience regarding incident frequency. The job experience exhibit good connection with incident frequency, but total cement industry experience was not a major issue in accident occurrence..

2.9.3 Health and safety culture

There is no sufficient safety culture and incident rate studies done by research people. (De Joy, 2005), The reasons to few studies on that area may be due to no proper safety culture develop within the organization or existing safety culture is very poor (Choudhry et al., 2007). Due to this reason the concept of safety culture is unclear and cannot be adopted perfectly in an organization. So safety culture to be identified as an integrated part of organization general culture which will influence attitudes and behaviors of the employees in an organization.

Schein, 1990 and Schein, 2004 defines organizational culture as people exhibit shared values and belief as a group while adapting within the organization. This concept cannot be measurable and observable. These basic assumptions are not readily observable or measurable as they are not visible. In Schein's understanding basic assumptions are similar to 'theories-in-use' (Argyris & Schön, 1996), which are the real hypothesis that totally govern behaviors of the workers. It is very difficult to distinguish these assumptions. There are more accessible two cultural layers are identified through effective analytical process and they are lined with their own beliefs and values (Argyris & Schön, 1996).

Schein pointed out if there suitable work environment and good initiative are present, the organizational culture could be change. Organizational culture could be considered

as controlling force that minimize despair of the workers, because it make origination frame that how workers behave ,think and feel in new changers. In other word culture could be considered as a concept that how people learn to act in changers ,make defense in uncertainty situations. (Schein, 2004). Therefore, cultural change may be a process that make unrest among workers .So changers to be introduced when three is a willingness within the people to take the change .Therefore organizations have to face critical situations like crisis, or dissatisfaction in existing stage to suitable change in its basic hypothesis . To have such huge change it requires double-loop learning rather than single-loop learning (Argyris & Schön, 1996), which could change only the outer layer of the culture.

With above literature review the meaning of health and safety culture could be a system of shared values and belief about the importance of health and safety in the work place

The meaning of safety attitude could pervade the whole organization from top to bottom and has become a norm of behavior for every member of staff from the board of directors to newest juniors

2.9.4 Job dissatisfaction

Industrial accidents pose a critical problem to a country which is on the threshold of industrialization. The social scientist in general and the industrial psychologist in particular have a keen interest on the problem.

Several researches have proved that accidents are linked with certain personality traits or characteristic (Speroff&Kerr, 1952; Davids&Mahoney, 1957). The idea that satisfaction of worker may have something to do with accidents is of comparatively recent origin. The present study attempts to explore this relationship. It has been conjectured that the satisfied worker is less likely indulge in accident behavior than the unsatisfied worker.

There are difference definitions were given to term job satisfaction Blum and Naylor (1968) the job satisfaction could be considered as the result of various attitude of an employee “In a narrow sense” write these authors, “these attitudes are connect to the job and are concerned with other specific issues such as payments, supervision level

, job security , work conditions ,positive opportunities, rewards and recognition ,unfair evaluation of work, employer behaviors etc.

Sinha (1972) holds that “job satisfaction covers both the satisfaction derived from being engaged in a piece of work or in any pursuit of a higher order. It is essentially related to human needs and their fulfillment through work. In fact job satisfaction is generated by individual’s perception of how well the job on the whole is satisfying various needs”

Recently the interactional theory of Vroom (1964) has been widely accepted as the for the term job satisfaction. Vroom has revealed that explanations of satisfaction require the use of work rule as also individual issues. Two main issues interact with each other .So any study on job satisfaction should consider both variables

2.10 Present status of health and safety issues in the construction industry in Sri Lanka

During review of research papers completed previously it is noted that there was high accident rate among outsourcing contractors in various industry in Sri Lanka. Also it was found that similar trend of accident occurrences among outsourced workers in the world. The following causes are identified by most authors. (DeJoy, 2005; Speroff & Kerr, 1952; Davids & Mahoney, 1957).

No	Reasons for high accident rates
1	Poor safety culture among contract employees as well as employers
2	Task oriented approach
3	Poor skill and competency
4	Substandard tool and equipment usage
5	PPE not suitable and sufficient
6	No job observation carried out
7	No skill development programs
8	Poor attention from Government bodies
9	Young workers
10	Uncertainty of the job

11	Under paid with respect to permanent employees
12	Poor working conditions
13	Poor welfare and no medical facility etc

The final outcomes will be stressed and discouraged of their occupation and change their focus on safety during work and tend to make accidents.

To reduce those gaps is difficult and should address under the following areas

- Environmental
- Organizational
- Job Factors
- Human & Individual Characteristics

There should be proper contractor management system in place and it should address above areas carefully. Contract owners should develop their safety system, their employees according to the Contractor management system and it will help to develop both contractors and contract owners and final reduce accidents rates among outsource contractors.

2.11 Summary

This chapter discussed the data collection and analysis methods. Collected data on numerous factors and analyzed how these factors affect accident, and their contribution. Also analyzed data collected from literature review from various countries, and how those findings related to Sri Lanka context.

CHAPTER 3

3 RESEARCH METHODOLOGY

3.1 Introduction

The research was conducted as a case study of a company to focus the link between accident present incident frequency and tasks performed by the outsource contract workers in construction company. To identify the link of those issues by analyzing the OHS related matters and the consequences of the workers activities.

It is focused to on the actual costs and benefits which will benefit to contract owners and their workers due to the safe behaviors of their employees. The main objective of this study is to highlight most relevant indicators, both quantitative and qualitative, to get empirical and evidence-based insight measures of the research

3.2 Research steps

This study follow three phases. The literature review to identify possible factors which are highlighted in previous research. The next step was conducting the safety observation tours to selected construction sites. The third step was check the attitudes of the workforce in respect of factors identified through the secondary data and the survey via a focus group interview. The survey was conducted on the project workers and office staff. The separate Survey questionnaires were given supervisory level workers to enable further exploration of the OHS commitment and perceptions of the behavioral safety factors identified within the literature



Figure 3.1 Research Process

3.3 Data Collection

3.3.1 Sampling techniques

Mainly two sampling techniques were used such as stratified sampling, and random sampling.

Stratified sampling

Stratified sampling is one of the probability sampling method which divides the total population into various subgroups then randomly selects the final subjects proportionally from the different sub groups. This sampling method is used because it reduces sampling error. In this method, supervisors and workers of permanent and outsourced categories were selected and put under subgroups (supervisors/workers) to ensure their actual representation in the population.

Both permanent and outsourced construction workers from selected work sites were stratified in four groups based on their responsibility, nature of tasks. Also, these four groups belong to two levels of employees. Those two levels include both permanent and outsourced employees.

Random sampling

In random sampling each member of the population has an same opportunity of selection and is carried out by numbering each item of the population examined. This method is then used to select a suitable number of subjects from each stratum. Randomly selected 12 work sites from the whole population (selected company belongs 30 work sites all over the country).Also the workers were selected haphazardly by work site safety officers and asked to answer to questionnaire.

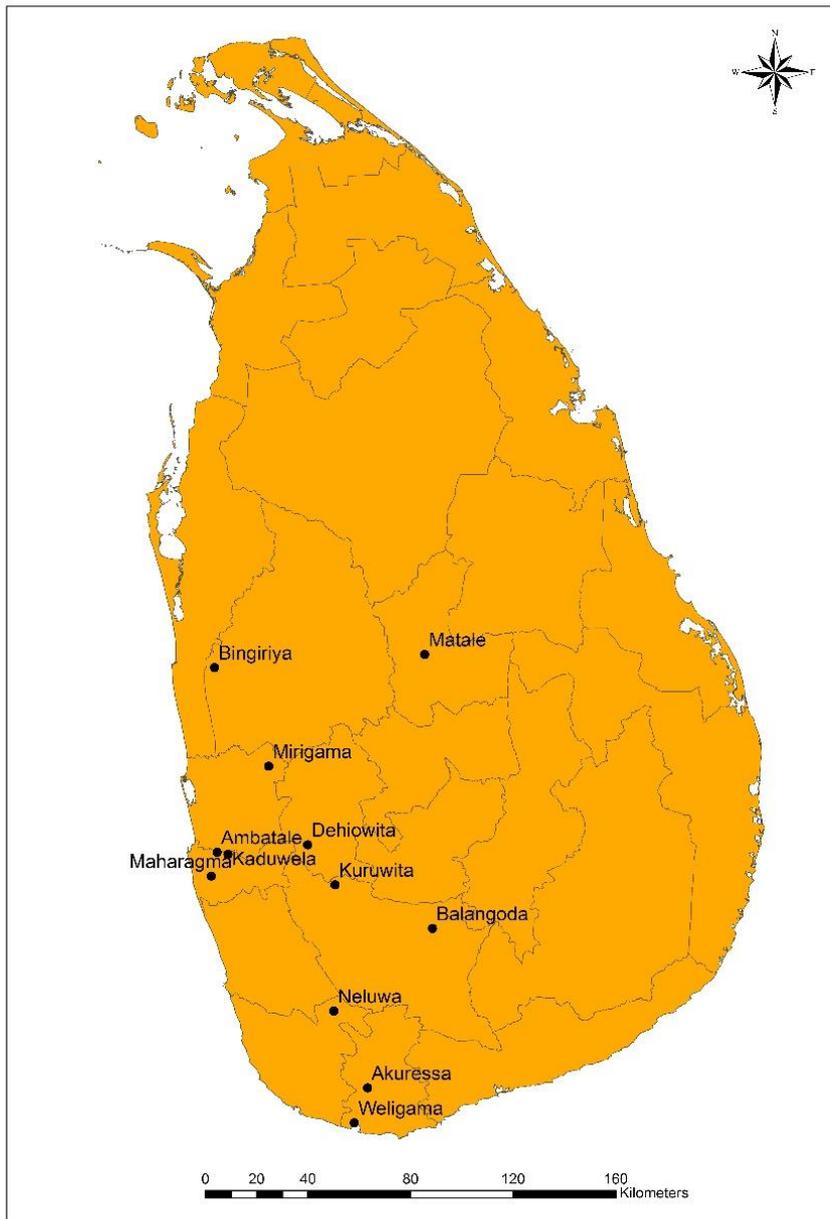


Figure 3.2 Location map of the sample data collected in Sri Lankan construction sites.

1. Waligama -South province
2. Akuressa-South province
3. Neluwa-South province
4. Balangoda Sabaragamuwa province
5. Kuruwita Sabaragamuwa province
6. Dehiovita Sabaragamuwa province
7. Matale Central province
8. Mirigama Western province
9. Bingiriya North west province
10. Maharagama Western province
11. Kaduwela Western province
12. Ambatele Western province

3.3.2 Method of data collection

Several meetings conducted with OHS staff of the above construction sites at the beginning of the assessment to identify the logic behind the different working standards of the construction sites. This allowed developing an understanding of the OHS concerns about historical and current accident incidents and related Personal protective equipment , tool, equipment and safety practices in the construction industry. Series of inspections also conducted with OHS management and inspection staff to identify the factors that caused the accidents in construction sites.

Both primary data (information collected from interviews, surveys, questionnaires, etc.) and secondary data (information collected by government departments, other organizational records with respective research locations) were used in this research. And qualitative and quantitative methods were used to interpret the results.

3.3.3 Primary data

Qualitative and quantitative data were collected as below

- Interview workers (Annex 02)

- Questionnaire survey with supervisors (Annex 01)
- Questionnaire on behavioral Factors from workers(in Table 4.10)
- Equipment inspection (Table 4.20)

3.3.4 Secondary data (Previous OHS related information collected from the selected company)

- Accident reports of 2014
- Accident investigation reports
- Training need analysis reports

3.4 Questionnaire Development

A survey questionnaire is developed while considering the literature review (Heinrich et al. (1936) -Domino theory), causes of accidents (De Joy, 2005), (Speroff & Kerr, 1952; Davids & Mahoney, 1957) including the related to information as inputs and outputs from the industry perspective. This sample questionnaire was given to three OHS professionals mentioned below to get their ideas and then finalized scrip prior to issue..

No 01 BSc Engineer -12 years' experience as Safety Manager

No 02 BSc Engineer 10 years' experience as Safety Manager

No 03 NEBOSH OHS diploma 20 years' experience as Safety Manager

- The questionnaire was to be simple to target group to complete. The questions mainly base on the construction sector regarding the unsafe behaviors and unsafe conditions created by workers
- The areas to be evaluated in this concept was as follows:
- The series of information received from officers in connection with safe behaviors which make positive impact on OHS in the construction field .
- The results/outcomes of the OHS related observations and how they enforce on safety in connected with construction work sites .
- The budget allocated to purchase safety equipment gear by contract agencies
- Training and awareness provided to sub-contractors of safety and health issues

- Result regarding the risk assessments carried out by enterprises in relation activities in construction sites
- The understanding of personal risk assessment of individuals
- The company satisfaction level with the available data and resources to prevent accident of work in construction site effectively;
- The types of assistance from the companies which value OHS to improve safety in work sites

3.4.1 Issue of Questionnaire

Hard copies of questionnaire were brought to 12 construction organizations (480 copies 240 for each category). A few workers regretted to answer due to literacy problems, but the safety officers of the construction sites supported in increasing response and get all the sites participated. Finally, both 240 permanent and 240 outsourced workers completed the questionnaire.

3.4.2 Industry visits

A key function of the questionnaire was able to contact ideal workers in construction industry for interview them and make that opportunity as OHS related facts finding forum.

Interviews were conducted among above sites and asked these people to a formal discussion which help to have productive discussion.

Interview Transcript (for work supervisors -Annex 02). These questions are prepared to check the safety culture of outsources supervisory level employees and permanent employees in same work sites.

3.5 Analyze Data

Data from survey, statistics and inspection were collected and then quantitative analysis was done to create logical graphs to ensure link between two or more factors which are significance to take logical decisions .

Also, data collected by interviews from focus groups questions and observations and use qualitative analysis and this analysis is useful explain why those things are occurring .

3.5.1 Quantitative Analysis

The areas analyzed from this section are as follows :

- Accident and incident data;
- Training program conducted;
- Educational and competency level details.

Discuss with the OHS managers and officers in work sites to collect required information line with lagging indicators in their work sites.

However, there were unavoidable constraints that limitations of the data provided which were reported accidents, and there may be underestimate levels of accidents in the construction industry.

Reporting levels was estimated by the labor department of Sri Lanka. Unfortunately, these data will not be available; So a clear picture of the trends with time is not possible.

Using this information, detailed analyses of accidents, will be prepared

3.5.2 Qualitative Analysis

The qualitative analysis was undertaken using three separate data gathering methods:

- Questionnaire;
- Interviews with workers
- Industrial visits

The result of the question papers were deeply analyzed and to interpret the relationship between OHS knowledge and unsafe behaviours.

3.6 Accident Data Analysis

Accidents resulting which victim unable to report three days continuously must be reported to the department of labor and it is known as lost time accidents. Reported accidents were analyzed related unsafe behaviors and conditions. The data includes fatal incidents involving permanent employees and contract employees which was caused by their work and incidents without lives loss sustained due to their

employment, who are unable to perform allocated their duties of their work three days continuously , without counting the day of accident happened.

Reporting

- Arrange final information to prepare initial draft report and action plan
- Coordinate and consultation with coordinate officer
- Presentation of final report

3.7 Summary

This chapter explains the methods of collecting relevant data from various locations Previous OHS reports. Questionnaire was prepared to check the OHS commitment of contract supervisors and knowledge of both supervisors and workers. Having received the data, analyzing was done checking the relationship of accidents with the knowledge and commitments of the workers.

CHAPTER 4

4 RESULTS AND DISSCUSION

4.1 Introduction

This chapter describes various relationship and correlations of between permanent and outsourced workers with regard to susceptibility of accidents. The accident trend analyzed with the age, education level, OHS knowledge, and behavioral factors etc.

4.2 Analyzing of accidents caused to outsource workers and permanent workers

The table 4.1 shows accident faced by outsourced workers in 2015 and 2016 at twelve construction sites. Figure 4.1 indicates the percentages of the workers met with accident and the workers they did not meet accidents.

Table 4.1 Accident statistic 2015 and 2016 of outsource employees at selected 12 locations

No	Site	Fatal accidents	Permanent disablements	Lost time injury	Medical treatment injury	Total	Total Workers	Accident %
1	Waligama	0	0	3	19	22	68	32%
2	Akuressa-	0	2	16	35	53	120	44%
3	Neluwa-	0	0	15	26	41	90	46%
4	Balangoda	0	1	9	48	58	135	43%
5	Kuruwita	0	1	12	47	60	143	42%
6	Dehiovita	0	0	11	40	51	98	52%
7	Matale	0	1	11	24	36	56	64%
8	Mirigama	0	0	12	12	24	123	20%
9	Bingiriya	1	2	11	34	48	243	20%

10	Maharagama	0	0	2	12	14	15	93%
11	Kaduwela	0	0	11	38	49	154	32%
12	Ambatele	0	0	12	14	26	112	23%
	Total	1	7	125	349	482	1357	35%

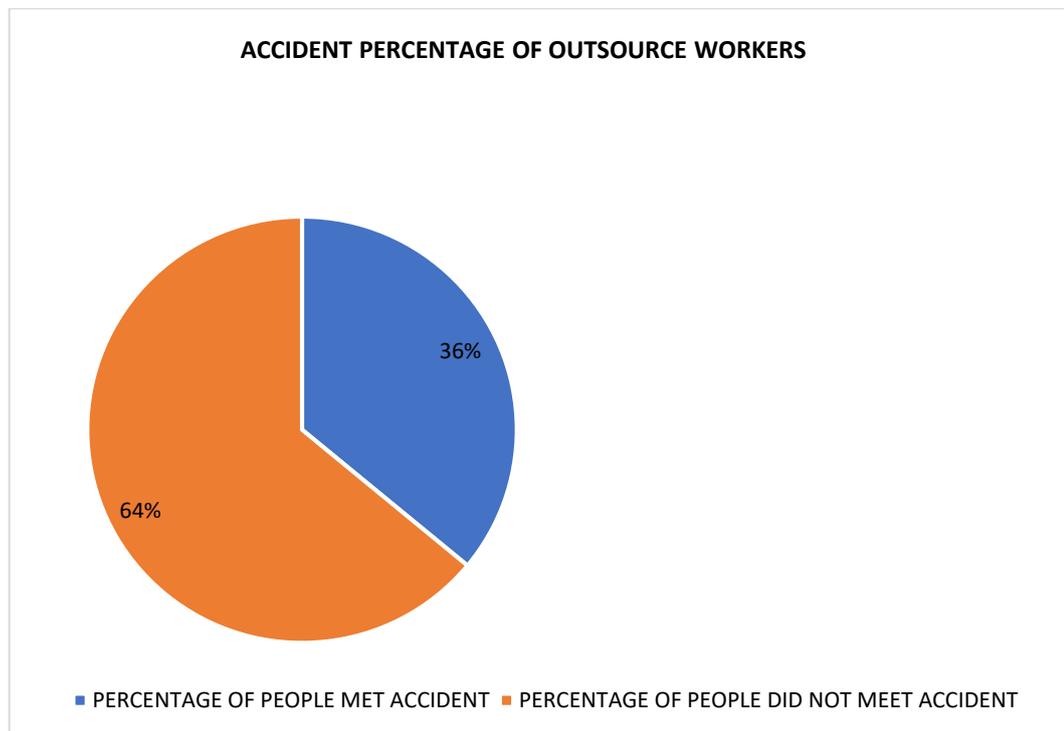


Figure 4.1 Accident percentage of outsource workers

When evaluating the accident details of years 2015 and 2016 of outsourced 36% workers has met some kind of accident (Figure 4.1). In other words, one worker out of every three workers suffered some kind of accident and 9% of workers suffered lost time injury whereas 26 % workers suffered medical treatment injury (Table 4.1).

The Table 4.2 shows accident faced by permanent workers (client's workers) in 2015 and 2016 at same construction sites. Figure 4.2 indicates the percentages of the workers met with accident and the workers they did not meet any accident

Table 4.2 Accident statistic 2015 and 2016 of permanent employees at selected 12 locations

No	Site	Fatal accidents	Permanent disablements	Lost time injury	Medical treatment injury	Total	Total Workers	Accident %
1	Waligama	0	0	0	2	2	20	10
2	Akuressa	0	0	0	3	3	38	8
3	Neluwa	0	0	1	1	2	31	6
4	Balangoda	0	0	1	5	6	49	12
5	Kuruwita	0	0	0	1	1	67	1.5
6	Dehiovita	0	0	1	3	4	45	9
7	Matale	0	0	0	1	1	43	3
8	Mirigama	0	0	2	7	9	56	16
9	Bingiriya	0	0	1	4	5	68	7
10	Maharagama	0	0	1	1	2	60	3
11	Kaduwela	0	0	2	5	7	80	9
12	Ambatele	0	0	1	4	5	49	10
	Total	0	0	10	37	47	606	8%

When evaluating the accident details of year 2015 and 2016 of permanent workers 8% workers have met some kind of an accident. In other words one worker out of every thirteen workers suffered some kind of accident 1.6% workers suffer lost time injury and 6 % workers suffered medical treatment injury. (The percentage of permanent work force accidents is lower than outsourced workforce)

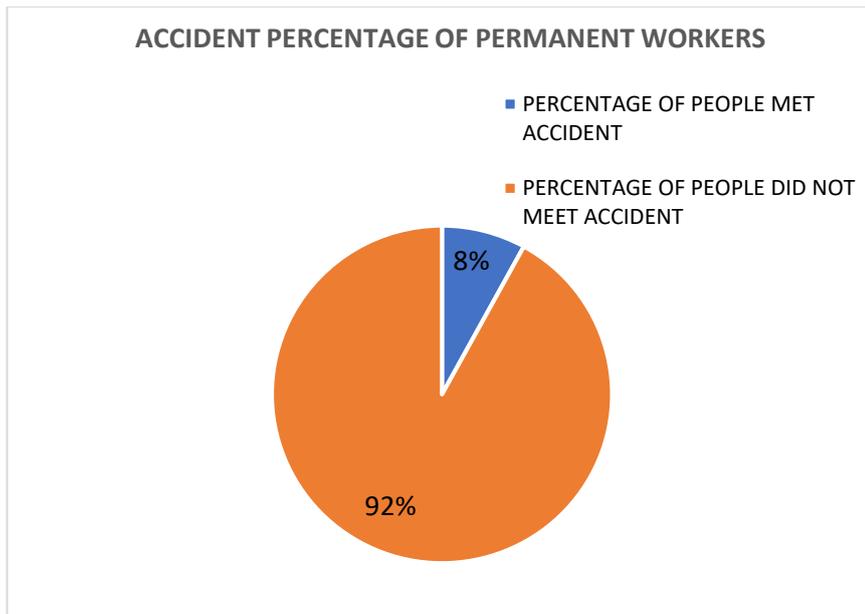


Figure 4.2 Accident percentage of permanent workers

The accident ratio of outsourced workers is 3:1, and the permanent workers ratio is 13:1. The possibility of an outsourced workers facing an accident is four time greater compared to permanent employees.

4.3 Data on accident category

Data on accident category of outsourced workers encountered on the above work site during last two years

Table 4.3 Accidents statistic of outsource employees (area wise)

No	Site	Working at height related (%)	Electrical related (%)	Fire related (%)	Others (%)	Total
1	Waligama	12	6	2	2	22
2	Akuressa-	26	18	6	5	53
3	Neluwa-	22	13	1	5	41
4	Balangoda	21	17	6	14	58
5	Kuruwita	28	13	7	12	60
6	Dehiovita	19	17	4	11	51

7	Matale	15	10	2	09	36
8	Mirigama	10	08	2	04	24
9	Bingiriya	20	16	4	08	48
10	Maharagama	6	4	1	03	14
11	Kaduwela	21	16	5	07	49
12	Ambatele	10	11	1	04	26
	Total	210	149	41	84	482
	Percentage	44%	31%	8.50%	17%	

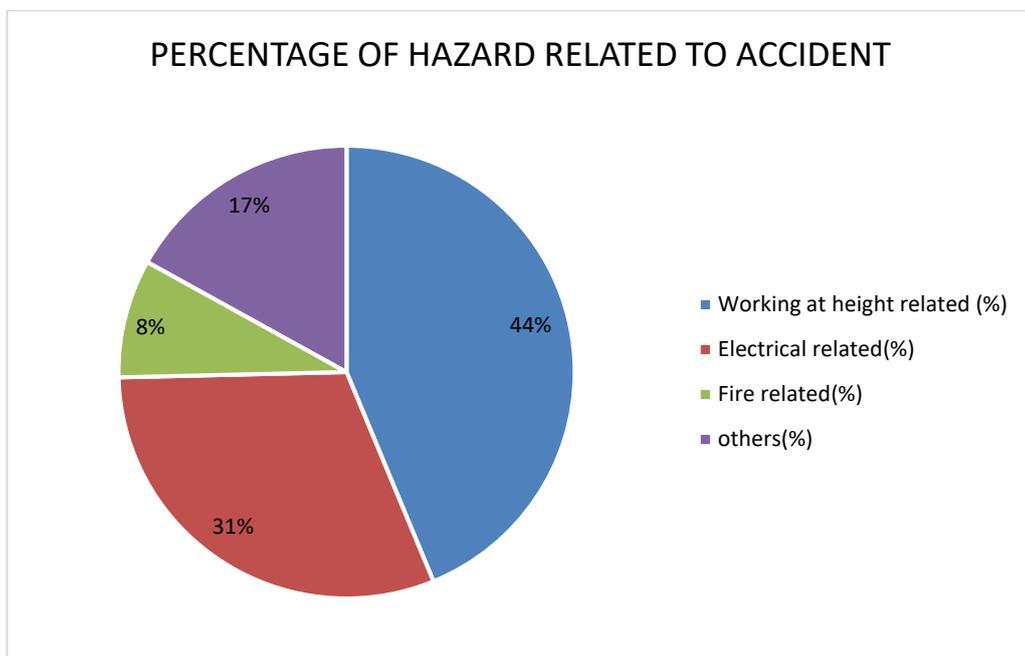


Figure 4.3 Critical hazard areas

While analyzing, it indicates falling accident percentage is 44% and Electrical related accident is 31% and Fire related accident was 8.5%

Hence the vulnerable areas are working at height, work with electricity and heat. So, training and awareness programs to be focused on these areas

Table 4.4 Managers vs. Workers

	Location	Permanent		outsourced	
		Managerial	Workers	Managerial	Workers
1	Waligama	8	20	2	68
2	Akuressa-	7	38	3	120
3	Neluwa-	8	31	3	90
4	Balangoda	9	49	2	135
5	Kuruwita	7	67	3	143
6	Dehiovita	8	45	3	98
7	Matale	7	43	2	56
8	Mirigama	11	56	3	123
9	Bingiriya	14	68	4	243
10	Maharagama	15	60	1	15
11	Kaduwela	9	80	3	154
12	Ambatale	6	49	2	112
	Total	109	606	31	1357
	Ratio	1	5	1	48

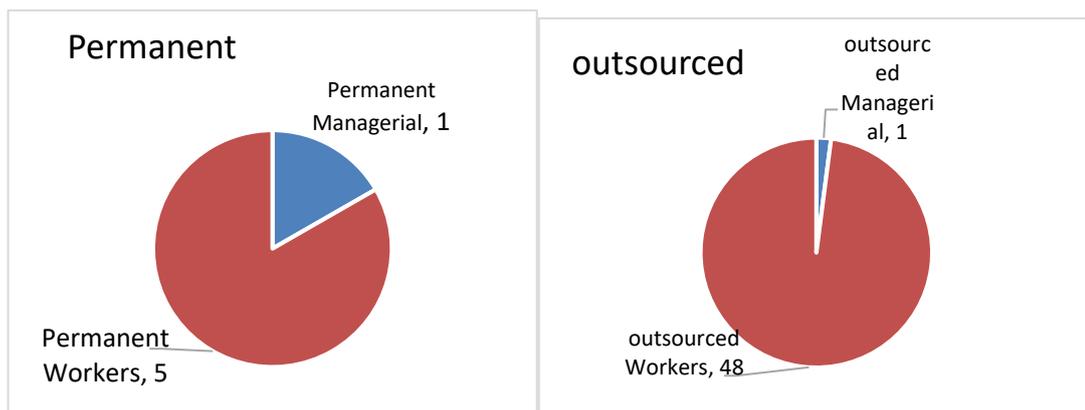


Figure 4.4 Comparison between number of supervisors for permanent and outsources workers

4.4 Education qualification of permanent and outsourced supervisors

Outsourced employees suffer with insufficient supervision but permanent work force have sufficient supervision (Table 4.4). In permanent staff the employees and supervisor ratio is 5:1 whereas this value on outsource employees is 48:1.

The supervision is a key factor to prevent accidents while guiding employees.

Construction projects require professional supervision to ensure that the construction work is executed with a high level of safety, quality and matches all agreed OHS plans.

The skillful supervision of a construction project requires vast knowledge on safety of construction activities in different areas as well.

Client can supervise a site themselves or delegate safety responsibilities to outsourced supervisors. Their job is to keep the site safe, even when they are not there. They should attend to the following.

- Know the site safety plan and make sure everyone sticks to it.
- Make effective risk assessment before start the task
- Ensure workers are inducted before they start work.
- Always know who is working on their site and conduct regular inspections.
- Be contactable
- Talk regularly with workers about safety on site.

The above causes are identified according to the previous research (De Joy, 2005; Speroff & Kerr, 1952; Davids & Mahoney, 1957).

In table 4.5 the education level of permanent (client's) supervisors is very high 93% supervisors have GCE (AL) and above education back ground, but 26% outsourced supervisors have GCE(AL) and above educational qualification.

72% client supervisors have specific supervisory qualification but only 10% outsource supervisors have such qualifications.

A construction supervisor's education requirement must focus on providing him with the skills needed to assess and inspect the progress of a construction safety implementation. There should be a thorough emphasis on building up skills through the means of correct and relevant education.

A construction supervisor's education must be substantial and encompass the most modern technical methods of imparting knowledge.

Education qualification of permanent and outsourced supervisors

Table 4.5 Education level of supervisors

	Permanent supervisors	percentage	Outsourced supervisors	percentage
University degree holders	60	56%	1	3%
GCE (AL)	40	37%	10	23%
GCE(OL)	5	4%	15	48%
Grade 8	3	2%	5	26%
Total	108		31	
Supervisory base trainings received	79	73%	3	10%

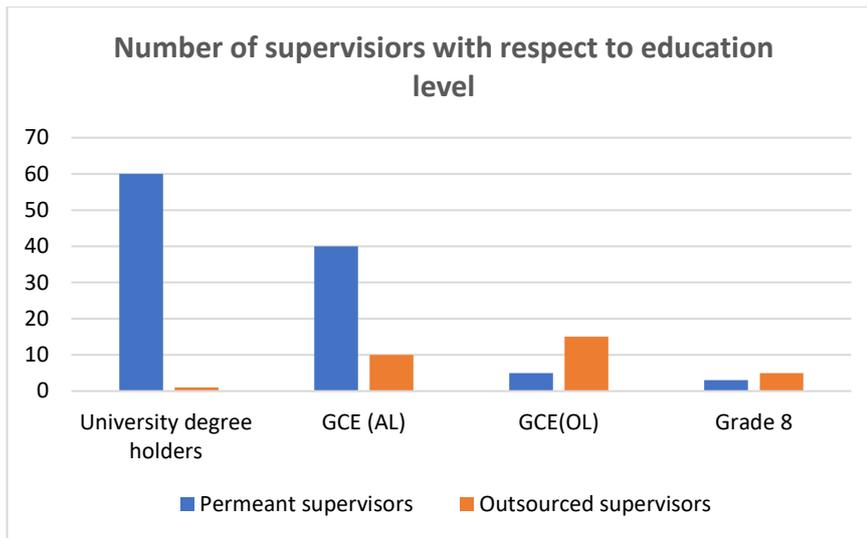


Figure 4.5 Education level of workers

Table 4.6 The education level of Selected 240 employee sample outsource employee

No	Education level	Number of employee	
1	Grade 8	143	59%
2	GCE OL	77	32%
3	GCE AL	16	7.5%
4	University degree	4	1.5%
	Total	240	

Table 4.7 Education level of Selected 240 employee sample permanent employee

No	Education level	Number of employee	
1	Grade 8	6	2.5%
2	GCE OL	182	76%
3	GCE AL	22	9%
4	Unversity degree	30	12.5%

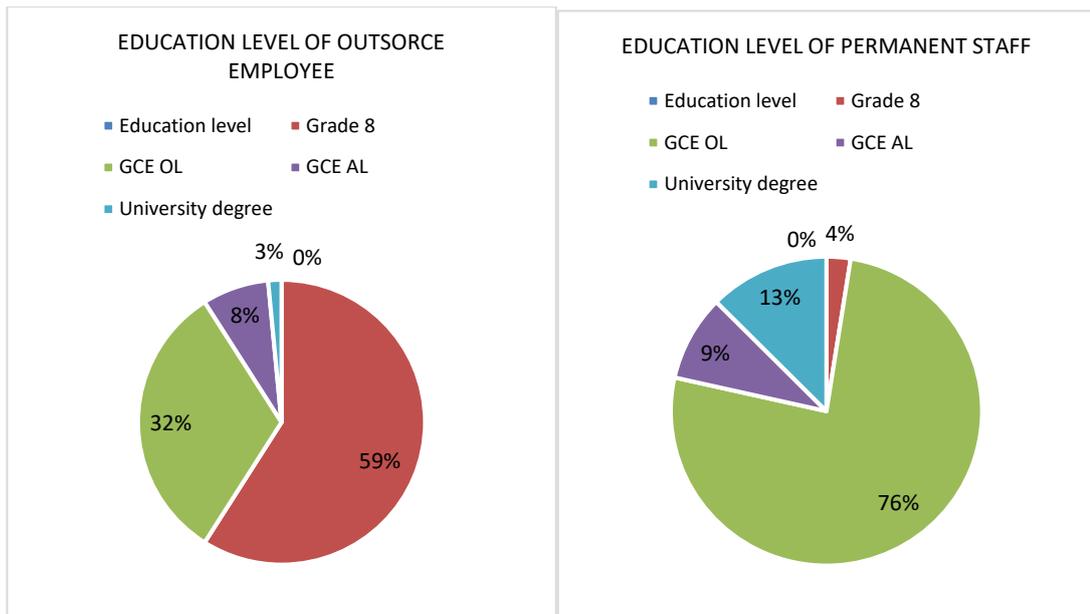


Figure 4.6 Comparison between permanent and outsourced workers education level

Table 4.6 shows that 118 workers (59%) who have grade 8 qualification engage in very high-risk activities, but only 40% workers have GCE(OL) and above qualification.

Table 4.7 depicts that there are 5 (2.5%) workers with grade eight qualification and they are involving in cleaning and tea preparing activities, but 95.5% workers have GCE(OL) and above educational qualification

Table 4.8 clearly shows the level of OHS knowledge of outsource workers. Safety knowledge on working at height, electrical safety and fire safety (which cause serious accidents) is very poor among outsource workers. It clearly shows that OHS knowledge of outsourced workers is very poor compared with permanent employees table 4.9.

Table 4.8 Depicts the occupational safety health knowledge (outsourced employees)

	Question related area	Aware	Not aware	Percentage of awareness
1	Causes of Accident	72	168	30%
2	Reason to investigate accidents	90	150	37%
3	Work on scaffolding	60	180	25%
4	Work on ladders	66	174	27%
5	OHS responsibility	60	180	25%
6	Oil spill prevention	66	174	27%
7	Power tool usage	54	186	22%
8	Fire fighting	54	186	22%
9	Electrical safety	48	192	20%
10	Environment protection	72	168	30%
	Total	27%	73%	

Construction workers need to be properly trained and educated on the task or job before working. It will assist in preventing incidents and injuries. There are many methods on training construction workers. One method is coaching construction site supervisors to include safety in their daily communication meetings with workers to reduce work-related accidents. It is important that the supervisors should use simple language that workers could understand to assure for the best communication. Another crucial point is that all workers should know how to properly use power tool and other equipment on the construction site. They should also, train on the job to properly maintain and inspect equipment and tool before and after their use. The equipment inspection system will help the workers to make sure that the machine is mechanically sound and in safe operating conditions. An employee should be assigned to inspect

equipment to ensure the proper safety measures are taken. Workers should ensure that the equipment is used for their intended task at all times on the job site to ensure safety of themselves and their colleagues.

Table 4.9 The occupational safety health knowledge (permanent employees)

	Question related area	Aware	Not aware	Percentage awareness
1	Causes of Accident	144	96	60%
2	Reason to investigate accidents	210	30	37%
3	Work on scaffolding	228	12	87%
4	Work on ladders	216	24	90%
5	OHS responsibility	180	60	75%
6	Oil spill prevention	204	36	85%
7	Power tool usage	192	48	80%
8	Fire fighting	168	72	70%
9	Electrical safety	150	90	62%
10	Environment protection	174	66	72%
	Total	(78%)	(22%)	

Each construction site should have a construction site manager or supervisor. He should have occupational health and safety knowledge to minimize potential injuries and accidents on construction sites. He is also responsible to conduct frequent safety talks and inspections to ensure safety environment of the work site

This table 4.9 illustrates the occupational safety health knowledge (permanent employees)

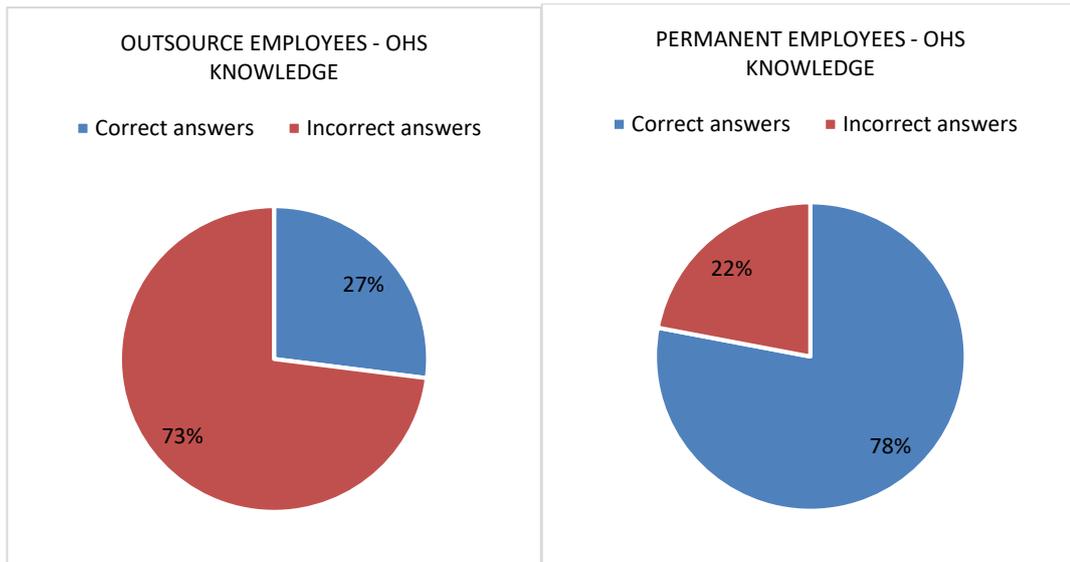


Figure 4.7 OHS knowledge of the employees

4.5 Behavioral Factors Contribute accidents

Workers have to mark 'always', 'sometimes', 'very seldom' by putting 'X' sign on reasons for accidents in work sites documents and the result displayed on table 4.10

Poor supervision experience/training, Safety culture, poor risk perception and risk taking were the most prominent factors, felt to 'always' contribute to on-site accidents.

Table 4.10 Behavioral factor

Behavioral factor	Always	Sometime	Very seldom
Alcohol and Drugs	189	40	11
Experience Training & competency	200	35	05
Supervision	156	54	30
Time pressure	125	74	41
Risk Perception	123	72	35
Risk taking behaviour	106	72	62
Shift pattern /stress	152	56	32
Safety culture	128	70	32

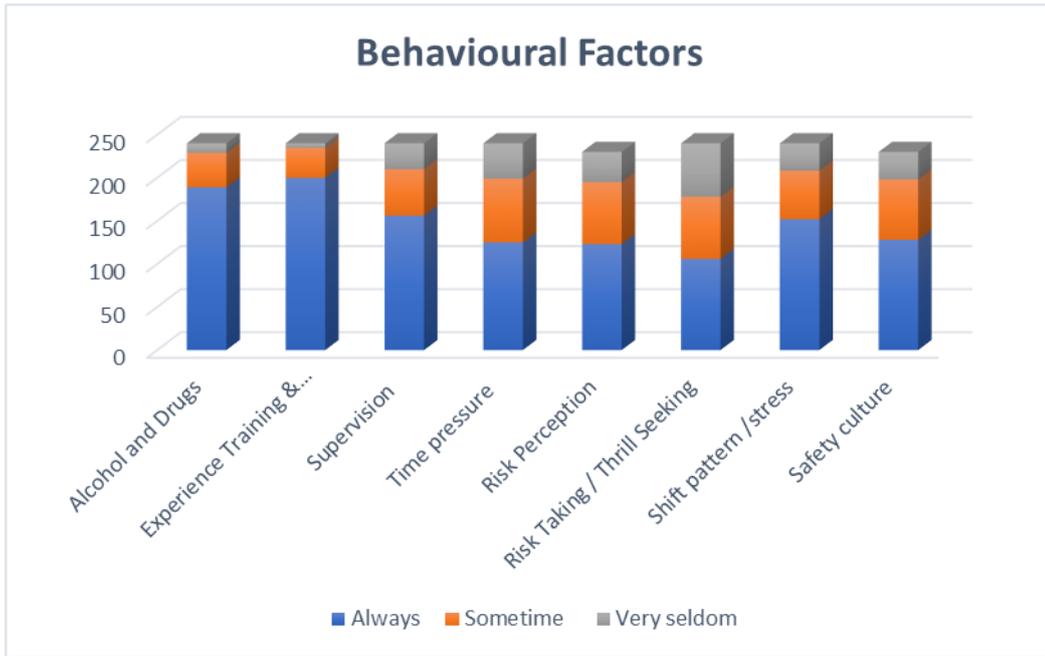


Figure 4.8 Behavioral factor

Table 4.11 Experience of Selected 240 employee sample (Outsourced)

No	Less than 1 year	More than 01y and less than 5 y	More than 01 Y and less than 5 y	More than 05 Y and less than 10 y	More than 10 Y and less than 20 y
	160	42	22	13	3
%	68%	17%	9.00%	5.40%	1%

Table 4.12 Experience of Selected 240 employee sample (permanent)

No	Less than 1 year	More than 01 Y and less than 5 y	More than 01 Y and less than 5 y	More than 05 Y and less than 10 y	More than 10 Y and less than 20 y
	33	134	43	25	5
%	13.50%	56%	18.00%	10%	2%

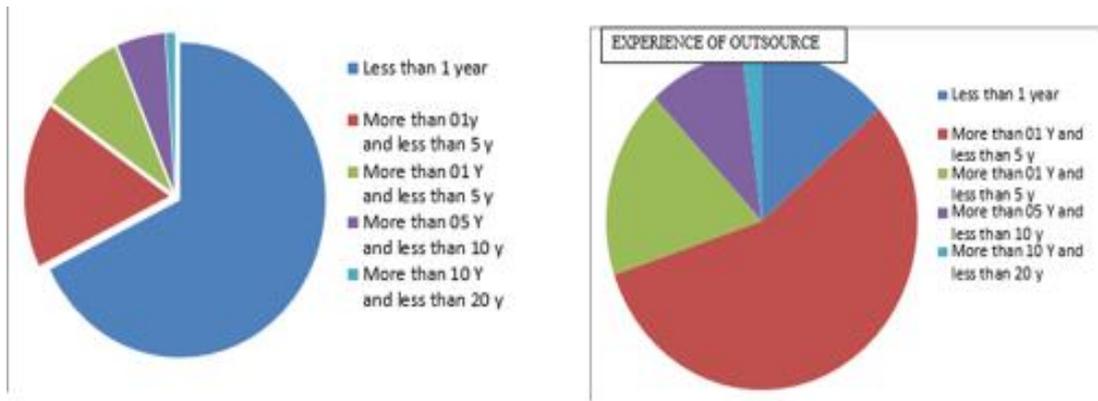


Figure 4.9 Experience of workers

According to the table 4.11 68% of workers have less than one year experience on construction site but with relevant to table 4.12 around 56% permanent (client's) employees have experience more than one year.

Table 4.13 Age limits and accidents

No	Site	Age less than 20	Between 20 and 50	Age more than 50	Total	Total Workers
1	Waligama	1	5	7	22	68
2	Akuressa-	20	20	15	55	120
3	Neluwa-	18	11	12	41	90
4	Balangoda	22	17	19	58	135
5	Kuruwita	21	16	23	60	143
6	Dehiovita	10	16	25	51	98
7	Matale	12	11	13	36	56
8	Mirigama	8	4	12	24	123
9	Bingiriya	18	12	18	48	243
10	Maharagama	7	2	5	14	15
11	Kaduwela	14	19	16	49	154
12	Ambatele	11	8	7	26	112
		161(33%)	141(32%)	172(35%)	484	

Table 4.14 Age distribution of 20 employee sample from 12 construction work sites (outsourced)

No	Site	Less than 20	More than 20 & Less than 50	More than 50	Total
1	Waligama	7	7	6	20
2	Akuressa-	7	6	7	20
3	Neluwa-	7	6	7	20
4	Balangoda	6	6	8	20
5	Kuruwita	7	6	7	20
6	Dehiovita	7	6	7	20
7	Matale	6	7	7	20
8	Mirigama	8	5	7	20
9	Bingiriya	8	6	6	20
10	Maharagama	5	5	10	20
11	Kaduwela	7	8	5	20
12	Ambatele	6	4	10	20
		81(34%)	72 (30%)	87(36%)	240

Table 4.15 Age distribution of Selected 20 employee sample from 12 construction work sites (permanent)

No	Site	Less than 20	More than 20 & Less than 50	More than 50	Total
1	Waligama	5	11	4	20
2	Akuressa-	6	9	5	20
3	Neluwa-	5	8	7	20
4	Balangoda	4	7	9	20
5	Kuruwita	5	9	6	20

6	Dehiovita	6	8	6	20
7	Matale	8	4	8	20
8	Mirigama	3	11	6	20
9	Bingiriya	2	13	5	20
10	Maharagama	8	11	1	20
11	Kaduwela	6	8	6	20
12	Ambatele	7	7	6	20
		65(27%)	106(44%)	69(29%)	240

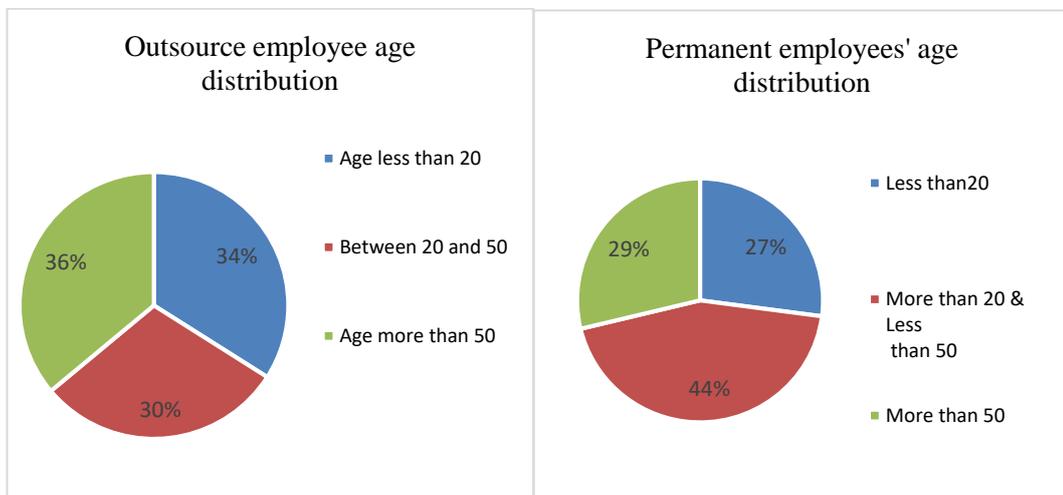


Figure 4.10 Age level of the workers

Three various levels of age groups were examined under table 4.13, which shows that the workers of age less than 20 years and more than 50 years experienced 68% of total accident and only 32% accidents happen to the workers in age between 20 and 50. Age and work experience significantly affected frequency and seriousness of accidents. The result of the findings shows that considerably higher rates of accidents are found among the youngest and the oldest employees.

4.6 Commitment to OHS

Interviews were conducted with 12 management level officers from both permanent and outsourced to measure the commitment towards to OHS by their management.

Table 4.16 Commitment level on OHS by Outsourced management

	Question to measure safety culture index	Yes	No	%
1	Availability of OHS training and awareness training program	2	10	16
2	Provided adequate training on Risk assessment/audit	4	8	33
3	Mechanism to identify hazards and report them	4	8	33
4	Pro-active measures to prevent accident	4	8	33
5	Do you satisfy the method/resources provided by organization to take actions for correct unsafe conditions	2	10	16
6	Organization investigate each incidents and accident	3	9	25
7	Availability emergency preparedness plan	4	8	33
8	Do you have any opportunities to involve OHS meeting /safety inspection events etc.	5	7	41
	Total	28	68	
	Percentage	29%	71%	

With their answers below table illustrate to commitment of the client company on OHS (permanent)

Table 4.17 Commitment level of OHS by Permanent management

	Question to measure safety culture index	Yes	No	%
1	Availability of OHS training and awareness training program	12	0	100
2	Provided adequate training on Risk assessment/audit	11	1	91
3	Mechanism to identify hazards and report them	10	2	83
4	Pro-active measures to prevent accident	11	1	91
5	Do you satisfy the method/resources provided by organization to take actions for correct unsafe conditions	12	0	100

6	Organization investigate each incidents and accident	9	3	75
7	Availability emergency preparedness plan	12	0	100
8	Do you have any opportunities to involve OHS meeting /safety inspection events etc.	10	2	83
	Total	87	9	
	Percentage	90%	10%	

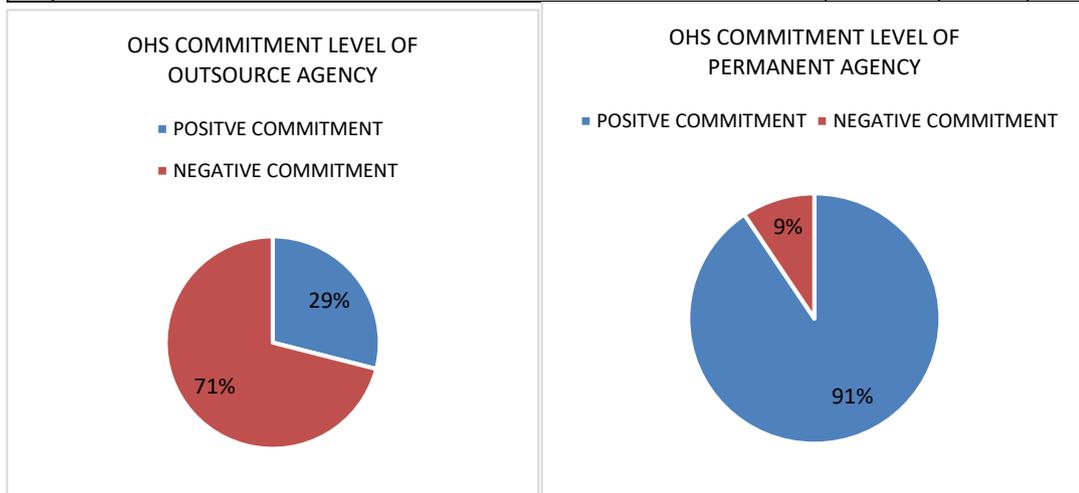


Figure 4.11 OHS commitment of management

Table 4.18 Specific training reserved for 20 selected employees sample (outsourced)

No	Training category	Number of workers
1	Fire fighting	4
2	Rescue and casualty handling	2
3	First aid	2
4	Working at height	4

Table 4.19 Specific training reserved to of Selected 20 employee sample (permanent)

No	Training category	Number of workers
1	Fire fighting	15
2	Rescue and casualty handling	12
3	First aid	12
4	Working at height	18

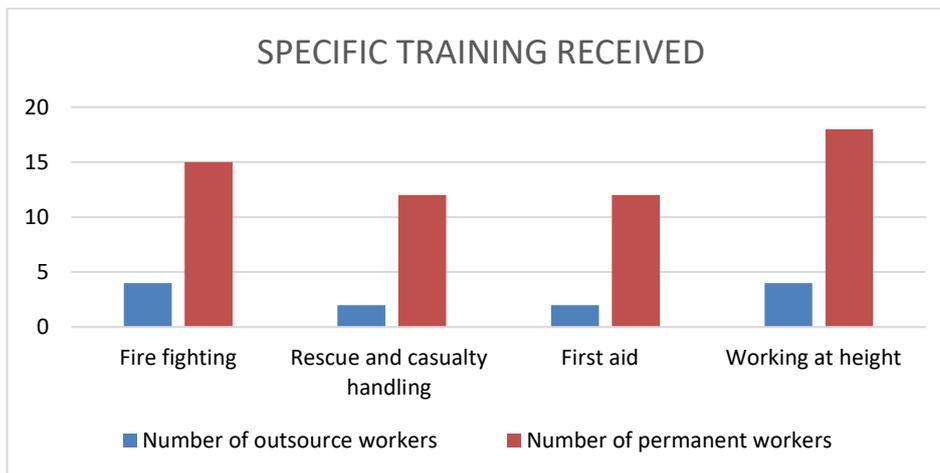


Figure 4.12 Specific OHS training

Randomly selected five Machinery and Equipment from two different sites and inspected their working condition

Table 4.20 Equipment and tool condition from randomly selected five equipment and tools

Equipment	Year of manufacture	Maintenance record	Appearance
Welding machine 01	Not clear	Not available	Not acceptable

Welding Machine 02	Not Clear	Not available	Not acceptable
Hand Grinder	2005	worker check before use	Fair
Electric drill	2004	worker check before use	Fair
Power hand saw	Not clear	Not available	Bad

Machinery or equipment also can cause major issues in the construction industry due to their sub standards and lack of mandatory safety provisions. Contract owners should purchase acceptable standard machinery and equipment and it should be mentioned in their contract agreements. The use of power tool ad machinery is another crucial issue. Hence, training plans should include these requirements.

Table 4.21 Random selection of 20 outsource workers and their PPE condition

PPE	Standard	Comments
Hard hat	No standard	No regular check
Safety shoes	No standard	16 shoes are damaged
Goggles	No standard	14 goggles not clear dust deposited
Gloves	No standard	Use same gloves for most task
Luminous Jackets	No standard	17Broken and not in good condition
Dust mask	No standard	Provided but not wear/only 2 workers wear, but poor quality
Safety harness	Comply with international Standard	But no proper training

Table 4.22 Random selection of 20 permanent workers and their PPE condition

PPE	Standard	Comments
Hard hat	Comply with international Standard	Annually checked /wearing is not 100%
Safety shoes	Do	shoes are in good condition 100% wearing
Goggles	Do	All goggles are clear no dust deposited /but only 8 workers wear
Gloves	No standard but good quality	Use various gloves for difference t task Only 12 workers wear
Luminous Jackets	No standard but good quality	All are in good condition and wear all
Dust mask	No standard but good quality	Provided but not wear/only 3 workers wear, but quality is good
Safety harness	Comply with international Standard	

4.7 Equipment and power tool inspection

Power Tool and equipment inspection was carried out on three major construction projects with the support of the safety officers at those locations

Table 4.23 Tool inspection

	Standard	Inspection frequency	Year of manufacture	Appearance
Bench grinder	No standard	Not done	2007	Not Acceptable
Hand grinder	With CE mark	Not done	2009	Fair

Electric arc welding machine	No mark	Not done	Not clear	Not Acceptable
Power saw	With CE mark	Not done	2007	Fair
Bar bending machine	No	Not done	Not clear	Fair
Pneumatic Hammer	No	Not done	Not clear	Not Acceptable
Concrete poker	Indian standard	Not done	2012	Good
Gas cutting set	Indian standard	Not done	2010	Good

4.8 Summary

This chapter includes the discussion methods of collected data analysis and comparing with several parameters with respect to permanent workers and outsourced workers in construction industry. Specially compare with accidents with the education level ,management commitment competency and experience of both outsourced and permanent workers Also analyzed how the quality of equipment, safety gear and the welfare facility affect to incidents in construction industry

CHAPTER 5

5 CONCLUSION AND RECOMMENDATION

5.1 Introduction

This chapter presents conclusions and recommendations with the research findings. This research targets achieving the objectives on outsourced contractors work the OHS related issues and work conditions while analyzing collected data and literature review.

5.2 Conclusions

In general accidents frequency in construction sites is reasonably in high level when analyzing accidents in other sectors . Among these accidents the majority victims are outsource employees. The study revealed that an accident happens to every 12-permanent employee whereas every 3- outsourced employee met with an accident (table 4-1 and Table 4-2) The table 4.3shows that working at height is critical cause of accidents and the second and third electrical and fire related. The head and neck were injured most often in construction accidents. Also the result tells that hand, leg and foot also contributed more accidents

Management commitment on OHS of the client company and outsourced organizations revealed that commitment on OHS of the client company is 90 % (table 4-15) the value of outsourced company is 29%(table 4-16)

During the analysis of the information collected, it is revealed that the following major reasons will be the causes to accidents to outsourced workers

Insufficient supervision

When analyzing (table 4-4) reveals that only one supervisor must supervise 48 outsource workers whereas one supervisor is appointed to every 5 permanent workers

Supervisors are not enough competent

Educational qualifications of permanent and outsourced supervisors have a significant difference. 74% supervisors outsourced supervisors are educated GCE (OL) and below, but 93% permanent supervisors have GCE (AL) above educational qualification. Only 10% outsourced supervisors received supervisory competency education, but this value is 72% for permanent supervisors. (Table 4-5)

No one takes the direct responsibility of OHS issues of outsource employee (both client / labour supplier)

No proper training on OHS

Outsource workers have to deal with high risk activities but they have low educational qualification (table 4.6)

Most equipment and tool used by outsource employees are of substandard and inferior quality. No regular inspections carried out. Safety provisions are not acceptable. That equipment causes serious accidents (table 4-20)

Not provide proper suitable and sufficient personal protective equipment (table 4-21)

The PPE used by permanent employees possess international standards. They undergo regular checking, but the percentage of wearing population is quite less (table4- 22)

No proper mechanism to identify hazards and report them (table 4-17)

The outsource agencies take 16% of effort to take corrective measures on identified hazards (table 4-16), but client companies take 100% effort on correcting the identified hazards. (table 4-17)

Do not investigate incidents and accident giving the same priority.

Only 25% of accidents were investigated on outsource agencies (table 4-16) but client companies investigate 75% of accidents (table 4-17)

- No effective emergency preparedness plan

- Limited opportunities to involve OHS meeting /decision making

5.3 Recommendations

With this study, it is very clear that outsource contract workers do and will continue to play a significant and ongoing role in the construction industry. With the available literature reviews and findings in Sri Lankan context stress that the task of managing occupational safety and health (OHS) at these operations is and will remain more complex. Also recommended here ensure suitable and sufficient measures to be developed and put in to action with the intention of mitigate the risks prevailing in with contractors' sites in Sri Lanka

5.3.1 Required commitment includes

Top management should exhibit demonstrated commitment and take visible leadership behavior in every day work which will enhance good occupational health and safety behavior. The demonstrated leadership style enhance participation by taking their positive involvement to ensure good health and safety measures on all activities. In addition the demonstrated involvement of supervisors and managers in OHS is a good example to encouraging employees to positively contribute to a health and safety culture within their organization.

The outsourced workers suffer insufficient training on OHS standard and quality equipment, effective supervision etc. Therefore systematic approach should be in place to overcome those gaps.

5.3.2 Training and awareness of the outsource workers

It is reveal that experience and skilled workers are less to prone to accident than inexperienced workers so the training and development play important part of accidents prevention

The basis for any OHS training programs including induction and other OHS related concepts will prevent of risk taking behavior and due to the knowledge gathering their OHS belief may be positively increased.

There are two main categories of training is recommended

- OHS induction at the beginning of the task (on the first day of the job)

- Specific training after having effective training need analysis of the workers

The contract agencies with the negotiation of client company necessary training programs to be implemented throughout the total construction period

Following key areas are recommended to include in OHS orientation programs

- Relevant safety Policies and OHS objectives with relevant to site work
- vulnerable and potential hazards exist at the site
- Site OH&S rules and regulation that works always adhere to .
- The place of first aid and medical facilities.
- available firefighting technics and resources .
- Current emergency response plan.
- The information of OHS related personnel .
- safety Committees and the responsibilities of them.

5.3.3 The other specific OHS training requirements

With the answers given by the workers to safety knowledge assessment their OHS knowledge is very poor under following categories

- Work at height
- Environment pollution prevention
- Electrical safety
- Firefighting training
- Vehicle and traffic safety
- Lifting and supporting loads

Hence, clients should ensure the outsource workers possess the above competencies before put them into work.

It is recommended to have effective process to evaluate the OHS competencies of the workers and proper training plan in place to fill any gaps associated with the OHS competencies

5.3.4 Contract Execution and Control

Supervision is a key issue in construction industry, the ratio of workers to supervisors for permanent workers 8:1 whereas outsourced workers 48:1

To ensure Occupational Health and Safety obligations are being fulfilled and risks associated with the type of work are being effectively managed. It is recommended to establish suitable processes to identify, assess and monitor the practices being applied during execution of the work by both the client and the outsourced Contractor. As a minimum, the following issues are recommended to manage between the client and the Contractor.

- Ensure effective supervision is available according to the task
- Educate them if they are unable to manage the risk in work place
- Establish minimum OHS competency of the outsource supervisors
- Establishing the means for informing outsource employees of the hazards
- arrange frequent safety observations and site inspections.
- Make tool and equipment inspection frequently
- Introduce user friendly reporting system.

5.3.5 Handover stage of outsource contact

Hence accidents are inevitable. So, proactive ownership is required to prevent potential accidents in the industry. The outsource workers should be competent and reliable to avoid accidents while on duty. The equipment and tool used by them should be of proper standard not causing accidents to the users. Therefore systematic approach is needed to minimize potential risk in the construction industry.

5.4 Further studies

The purpose of this study is mainly to identify the real causes of accidents in constructions and manufacturing fields and to suggest practical solutions to eliminate or mitigate risk of workers concerned. So the next step will be to drill down each reason found from this research and find why workers do not realize the negative consequences of their unsafe behaviours and why they continue to work in unsafe work environment.

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7 APPENDICES

Annex 01 Quiz for workers

Please answer below question

1. To complete any task without an accident
 - a. Experience is required
 - b. Proper equipment needed
 - c. Proper work plan needed
 - d. All above are correct

2. Why accidents to be investigated
 - a. To take disciplinary actions for responsible workers
 - b. To identify real causes and prevent recurrence
 - c. It is a mandatory requirement of the government
 - d. To claim insurance payments

3. .How could you prevent accident while working on scaffolding
 - a. Wear safety harness when needed
 - b. Erect scaffolds under supervision of competent person
 - c. Get approved scaffolding before use
 - d. All above

- 4.What is the correct statement regarding use of ladders.
 - a. you could bring your tool by one hand while ascending or descending
 - b. You and your assistance could climb on ladder simultaneously
 - c. Always ladders should be kept in vertical position
 - d. Only One person could climb at once

5 What is your OHS role while working in the site

- a. Wear given PPE if they comfortable to wear
- b. Inform potential hazards when detected
- c. Follow the instruction given by the supervisor
- d. b and c both are correct

6 If you see any oil spillage in your site what should you do?

- a. Prevent further spill using available resources
- b. Wash the area using water bucket
- c. Put on the sand and cover it
- d. Do not take any action as it will evaporate during few days

7. Before using power (electrical) tools

- a. Check the rating on the label
- b. Check for broken parts
- c. Check that the handle is black
- d. All of the above

8. If you see a fire at your site you should

- a. Put water on it
- b. Evacuate immediately from the area
- c. Try to extinguish it using fire extinguishers if you know the operation
- d. Do not take care it is not your responsibility

9. If you see someone contact with live electric wire and ask help what you do

- a. Try to remove him with bare hand
- b. Remove him using rod or another pole

- c. Do not touch and inform electrical authority
- d. See the possibility of power off and try to remove him using a dry rod

10 . Why does a work environment need to be kept clean?

- a. To prevent spread of fire in an emergency
- b. To reduce the risk of slips and falls -
- c. To protect the environment
- d. All of the above

1. අනතුරකින් තොරව කාර්යයක් සම්පූර්ණ කිරීමට
 - a) පළපුරුද්ද නිබිය යුතුය
 - b) හොඳ උපකරණ නිබිය යුතුය
 - c) හොඳ වැඩ සැලැස්මක් නිබිය යුතුය
 - d) ඉහත සියල්ලම නිවැරදිය
2. අනතුරක් විමර්ශනය කරනුයේ
 - a) අදාල සේවකයින්ට විරුද්ධව විනය ක්‍රියාමාර්ග ගැනීමටය
 - b) නිවැරදි හේතුව සොයා ගැනීමට සහ එය නැවත සිදුවීම වලක්වා ගැනීමට
 - c) එය කිරීම රජය අනිවාර්ය කර ඇති නිසා
 - d) රක්ෂණ වන්දි ලබා ගැනීමට
3. පලංචි මත වැඩ කිරීමේදී සිදුවිය හැකි අනතුරු වලක්වා ගත හැක්කේ
 - a) නිසි අවස්ථාවලදී ප්‍රවේසම් බදපටි පැලඳීමෙනි
 - b) නිසි පුහුණුව ඇති සේවකයින් යොදා ඒ සඳහා සුදුසු කම් ඇති නිලධාරී මහතකුගේ අදීක්ෂණය යටතේ පලංචි ඉදිකිරීමෙනි
 - c) භාවිතයට පෙර එය අනුමත කරවා ගැනීමෙනි
 - d) ඉහත සියල්ලම නිවැරදිය
4. ඉනිමංභාවිතයේදී නිවැරදි ප්‍රකාශය වන්නේ
 - a) ඉනිමගමන ඉහලට හෝ පහලට ගමන් කරන විට එක් අතකින් ඔබගේ උපකරණ ආයුධ රැගෙන යා හැකිය
 - b) ඔබට සහ ඔබගේ සහෝදර සේවකයකුට එකවර ඉනිමග ගමන් කල හැකිය
 - c) සෑම විටම ඉනිමග සිරස්ව තබා ගත යුතුය
 - d) එක්වරකට ඉනිමග ඔස්සේ ගමන් කල හැක්කේ එක් අයකුට පමණි
5. වැඩ බිමකදී ඔබගේ සුරක්ෂිතතාවය ඔබගේ භූමිකාව වනුයේ
 - a) ඔබට පහසු අවස්ථාවලදී ප්‍රවේසම් උපකරණ පැළඳ කටයුතු කිරීම
 - b) අවදානම් අවස්ථා දුටුවහාම ඒවා අදාල නිලධාරීන්ට දැනුම් දීම
 - c) වැඩ සුපරීක්ෂක ලබාදී ඇති උපදෙස් අනුව කටයුතු කිරීම
 - d) b සහ c යන ප්‍ර කාශ දෙකම නිවැරදිය

6. ඔබගේ වැඩබිමේ යම්තෙල්ඉසිරිමක්දුටුවහොත්ඔබකලයුත්තේ
 - a) තිබෙන සම්පත්උපයෝගීකරගෙන තවදුරටත්තෙල්ඉසිරිම පැතිරීම වැලැක්වීම
 - b) වතුරබාල්දියක්ගෙන සෝදාහැරීම
 - c) වැලියෝදා එය වසාදැමීම
 - d) එය දිනකිපයක්තුල වාෂ්පවියනබැවින්කිසිවක්නොකළයුතුය

7. විදුලිඋපකරණ භාවිතයට පෙර
 - a) එය අදාලකටයුත්තට ගැලපේදයන්න විමසාබැලීම
 - b) දෝෂසහිත කොටස්තිබේදැයි බැලීම
 - c) හැඩලය කැඩීඇතිදැයි විමසාබැලීම
 - d) ඉහත සියලුමනිවරදිය

8. ඔබගේ වැඩබිමේ ගින්නක්ඇතිවී ඇති අවස්ථාවක ඔබකලයුත්තේ
 - a) එයට වතුරගසා නිවාදැමීම
 - b) වහාම එමස්ථානයෙන්ඉවත්වීම
 - c) ගිනිනිවීමපිළිබඳ ඔබටපුහුණුවක්ඇත්නම්වහාම ඒසඳහා මැදිහත්වී ගින්නනිවීමට උත්සාහකිරීම
 - d) ගිනිනිවීම ඔබගේ කාර්යයක්නොවන බැවින්එයට මැදිහත්නොවීසිටීම

9. යමෙකු සජීවීවිදුලිපරිපථයක ස්පර්ශවීසිටිනම්
 - a) අතින්ඇඳ ඔහුව ඉවතටගැනීමට උත්සාහකිරීම
 - b) වියලිදණ්ඩක් /පොල්ලක්බාවිතයෙන්ඔහුවඉවත්කිරීමට උත්සාහකිරීම
 - c) වහාම විදුලිබලමණ්ඩලයට දැනුම්දීම
 - d) විදුලියවිසන්ධිකිරීමටඇතිහැකියාව සොයාබලා එයවිසන්ධිකරවියලිදණ්ඩක් /පොල්ලක්බාවිතයෙන්ඔහුව ඉවත්කිරීමට උත්සාහකිරීම

10. වැඩබිමක්තුල මනාපරිසරපවිත්‍රතාවයක්පවත්වාගතයුත්තේ ඇයි
 - a) හදිසිගිනිගැනීමක්සිදුවුවහොත්එයපැතිරියාම වලක්වාගැනීමට
 - b) ලිස්සායාම් /පයපැකිලීවැටීම්වැනිඅනතුරු වලක්වාගැනීමට
 - c) පරිසරයපවිත්‍රතාවතබාගැනීම මගින්සේවකයින්ගේ මානසිකතත්වය ඉහලමටටමක තබාගැනීමට
 - d) ඉහතසියලුමනිවරදිය

Above multiple questioner was given to 240 outsourced workers and 240 permanent workers selected randomly from various construction sites in Srilanka and to evaluate OHS knowledge of these workers

In this table it is clearly see that OHS knowledge of outsource on working at height electrical safety and fire safety is very poor among outsource worker

Annex 02 OHS commitment searching questionnaire

1. Has there any OHS training and awareness training program/schedules in your project
2. Provided adequate training on Risk Assessment ,safety audit ? Pls. explain.

3. Is there any mechanism to identify hazards and report them in your site?
4. Is there any pro-active measures to prevent accident in your site
5. Do you satisfy the method/resources provided by organization to take actions for correct unsafe conditions
6. Do your organization investigate each incidents and accident and take preventive and corrective action
7. Is there any emergency preparedness plan implement in the site
8. Do you have any opportunities to involve OHS meeting /safety inspection events etc.

Annex 03PPE standard

Inferior quality helmets used
by contractors



Figure 7.1 Inferior quality helmet

Inferior safety shoes used
by contractors



Figure 7.2 Inferior quality shoes

Inferior quality luminous jacket used by contractors



Figure 7.3 Inferior quality jacket

Inferior quality spectacles used by contractors



Figure 7.4 Inferior quality spectacles

Inferior quality gloves used by contractors



Figure 7.5 Inferior quality gloves



Figure 7.6 unsafe conditions in construction sites

standard helmets
used by client
company workers



Figure 7.7 Standard helmet

Equipment test tag used by host company



Figure 7.8 Equipment test tag



Figure 7.9 Standard safety harness

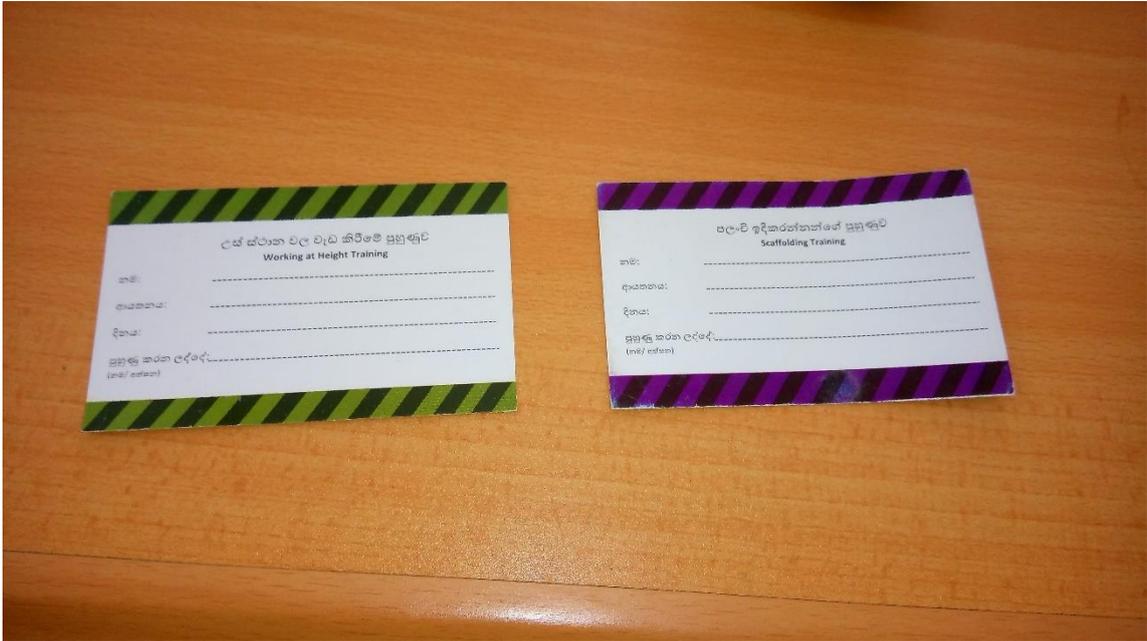


Figure 7.10 Training cards used by host company



Figure 7.11 Safety awareness to client workers before start work