

## **A Framework for Enhancing Occupational Safety and Health in Cement Manufacturing Industry in Sri Lanka**

Wijayaweera, A.W.D.H.,

*University of Moratuwa, Sri Lanka*

*dilhemantha7@gmail.com*

Dissanayake, D.M.P.P.,

*University of Moratuwa, Sri Lanka*

*piumi2d@gmail.com*

Fayasa, A.F.,

*University of Moratuwa, Sri Lanka*

*aariffaya@gmail.com*

### **Abstract**

Occupational Safety and Health (OSH) as the science and art of the anticipating, recognizing, analysing and monitoring of hazards arising in the workplace that could harm the health and well-being of employees. Comparatively in the manufacturing industry, OSH is considered as an essential requirement to achieve expected production targets without any disturbances. Most of accidents, injuries and health diseases are created at working phase in the industry. This has been a significant issue in cement manufacturing industry because Sri Lankan cement manufacturing industry employs large number of employees where many OSH issues are presented due to complexity of the manufacturing process and due to many other reasons. Though the practice of this concept increases over world, very less number of researches have been conducted related to the OSH in the cement manufacturing industry in Sri Lanka. It has become a timely requirement to ensure the safety of the employees who are working in the cement manufacturing industry. Therefore, this study attempts to develop a framework for enhancing OSH in cement manufacturing industry in Sri Lanka.

Initially, a comprehensive literature review was carried out to enlarge the existing knowledge on safety and health issues associated with the employees in the cement manufacturing industry and its effect on workers and society. In order to validate the research finding, semi-structured interviews were conducted among the three-different level of professionals including managerial level, supervisor level and labour level from each case. Collected data from the interviews was structured and analysed with the support of NVivo software. Empirical investigation addressed physical accidents, injuries and various kind of health diseases were the main issues in the cement industry. It was further identified that these issues are occurred by workplace hazards i.e. excessive cement dust, machines with moving parts, heavy vehicle movement etc. and other factors i.e. poor working relationship among workers, risky attitudes and behaviour of the workers etc. Although, plenty of activities have been taken placed to ensure OSH in workplace, some challenges including, fund allocation, ensuring the safety of contract employees, unrealistic production targets, ensuring the safety of customers and other outside parties and negligence of safe work instructions by employees were validated. Finally, a framework was developed based on the empirical research findings to enhancing the OSH in cement manufacturing industry in Sri Lanka.

**Key words:** Cement Manufacturing Industry, Challenges, Occupational Safety and Health

## INTRODUCTION

Occupational Safety and Health (OSH) defined as the science and art of the anticipating, recognizing, analysing and monitoring of hazards arising in the workplace that could harm the health and well-being of employees (Alli, 2008). As per the study of Alli(2008) various types of occupational issues including accidents, diseases and sicknesses are created in work environment. International Labour organisation (ILO) (2016) has published, a worker dies from a work-related accident or disease in every 15 seconds and 153 workers have a work-related accident in every 15 seconds. Further details of ILO (2016), 6300 workers die in every day as a result of work related diseases or occupational accidents. Moreover, economic burden of poor occupational safety and health practices have been estimated at 4 percent of global Gross Domestic Product (GDP) each year as per the statement of ILO (2016). WHO(2001), there are hazards in working environment and workers are exposed to those hazards. Occupational diseases and adverse health conditions can be occurred due to those hazards. Some other factors like unclear tasks allocation, delays in receiving some inputs, and request for rework of some previously completed can also affect to create OSH issues (Banyen , 2016)

When considering the cement manufacturing industry, occurrence of accidents and hazards are frequent and influence to the human health to create various health issues (Town et al., 2016). Quarrying, crushing, clinker production, milling processes at raw mill, cement milling and coal milling, material transport, filtering, storage, loading and delivery of final products, fuel storage activities, are the main steps in the cement production process and various kinds of hazards are created in these steps (Tomar, 2014).

Workers in the cement factories are facing various diseases in breathing, chronic bronchitis, asthma, emphysema, lung cancer, pneumonia, tuberculosis, shortness of breath, cough, wheezing, stroke, chest pain, irregular heartbeat, swelling in legs and feet (not caused by walking), eye irritation, skin allergies, anxiety and fatigue (Sana, Bhat, & Balkhi, 2013). As well physical accidents and injuries are also happened(Rachid, Ion , Irina, & Mohamed, 2015). In addition to these hazards, not practicing and following safety procedures by developing countries in cement factories including lack of accurate information and records of occupational diseases and accidents, lack of effective enforcement system, lack of professional training are identified as major causes for health and safety issues (Town et al., 2016). However, providing a safety and health work environment becomes a timely requirement in the cement manufacturing factories(WBCSO, 2004). While the necessity of OHS identified by the

industrial practitioner, still the practice of concept is poor due to the lack of studies on relevant area. Therefore, this study is aimed to develop a framework for enhancing OSH in cement manufacturing industry in Sri Lanka.

#### LITERATURE REVIEW

This paper commenced with comprehensive literature review, which basically covered the areas; Occupational Safety and Health (OSH); OSH in Cement Manufacturing Industry; OSH issues in cement manufacturing industry; leading causes of identified OSH issues; and Safety practices to mitigate causes of OSH issues in cement manufacturing industry.

##### Occupational Safety and Health

Occupational Safety and Health (OSH) is the providing a safe environment with avoiding hazards which affected to create injury or harm to the employees(Western Australia, 2005). It is a very important concept, not only for ensuring the health of workers, also helps to increase productivity, enhance the product quality, maintain the job satisfaction, improve work motivation and upgrade the overall quality of individuals and society(Franklin, 2015). Cost for the work related issues can be directly or indirectly related with the organisation (Mazzolini, 2012). According to, ILO(2016), total costs for the occupational accidents are 4% of the gross national product (GNP)(Hamalainen, Takala, & Saarela, 2006)

##### OSH in Cement Manufacturing Industry

Among the manufacturing sector, establishment of OSH in cement manufacturing industry due to the nature of cement manufacturing process is being carried out. A considerable attention should be given to the health and safety aspect of the employees in the cement industry.

##### Cement manufacturing industry

Cement is the major raw material used for preparing concrete and introduced and produced in 1824 in British era. Currently, about 1,700 million tons of cement is produced annually to use for the various types of manufacturing purposes to fulfil various types of physical and chemical requirements(Hokoma, Khan, & Hussain, 2008). Total cement production increased about 73% between 2005 and 2013 from 2310 Mt to 4000 Mt to fulfil global cement requirements(Mikul, 2016). According to Economic and Social Statistics of Sri Lanka, Central Bank Annual Report (2015), Cement is a highly consuming material and total consumption is about 6.4 Mt per annum in currently(Lokugamage, 2016).

### Occupational safety and health issues in cement manufacturing industry

When considering about the cement manufacturing industry various types of physical accidents and injuries are happened in various stages of the cement production process. Mainly physical accidents and injuries consisting with fatality accidents, permanent disabilities, loss time injuries and first aid treatment injuries (Rachid, Ion , Irina, & Mohamed, 2015). Most available safety diseases among workers in cement manufacturing industry are the respiratory problems, liver and lung diseases, fatigue and headache(Musa, Bamidele, Salaudeen, Saromi, & Aa, 2012). Workers in cement industry suffer from cancer, breath problems, skin problems and eye problems as a result of not applying adequate of appropriate PPEs (Town, Victor, Atsango, Solomon, & Africa, 2016). In addition to, following diseases are most common to the workers in cement industry i.e. asthma, chronic bronchitis, pneumonia, emphysema, tuberculosis, cough, lung cancers, wheezing, chest pain, swelling in legs and feet, stroke, irregular heartbeat, high blood pressure, fatigue and anxiety (Sana, Bhat, & Balkhi, 2013).

### Leading causes of OSH issues in cement manufacturing industry

Various hazards are exposed to workers in cement factories during cement production (Aminian, Aslani, & Sadeghniaat Haghghi, 2014). Sana et al., (2013),exposing cement dust is caused respiratory problems to the workers. Cement cause to create ill health in cement workers including skin, eye contact and inhalation problems (Town et al., 2016). Noise is a common hazard which is generated during the cement manufacturing and production process, when raw materials grinding in milling plants huge amount of noise is generated and damage to the hearing level of maintenance and cleaning works at risky area (Town et al., 2016). Other health workplace hazard in cement manufacturing industry could be identified as machines with rotating and moving parts, vibration, vehicle and traffic hazards, danger atmosphere, toxic chemicals, fire, electrocution, drowning, high temperature, radian hazards and poor work environment (WBCSO, 2004)

There are number of causes for work related accidents in cement plants including, lack of experience, knowledge and motivation, poor working relationships among workers, complex situation in the workplace, lack of communication and awareness, careless activities, urgent operation activities, lack of preventive strategies, lack of awareness of worker's responsibilities, lack of resources to support and deploy for health and safety, inadequate

strategies related to health and safety, lack of involvement of employees, less evaluation of consequences and occupational injuries, lack of awareness of perspectives related to the health and safety, lack of information, financial resources and human resources to effectively manage and improve the health and safety at work (Mounia, Rachid, & Yahya, 2017). According to Town et al. (2016), main causes for OSH issues could be, inadequate supervision of the employees, risky attitudes and behaviours of workers in the work place, less education on safety, not using proper safety harness methods, not adequately provide the safety harnesses, incompetent and unqualified safety officers are provided by the sub-contractors, managers do not consider the basic health and safety of workers employed by the sub-contractors in factory, PPE are not properly used by the workers, providing defective PPE to the workers in factory, equipment in the workplace are not properly used by the workers.

#### Safety practices to mitigate causes of OSH issues in cement manufacturing industry

Proper management and leadership attributes are most essential to continue safety management practices (Hee & Ping, 2014). Workers should be encouraged to communicate each other about workplace hazards to take appropriate actions to solve work related problems (Connor, Flynn, Weinstock, & Zanoni, 2015). To improve safety conditions in the organisation, management give offers and rewards to the workers. Companies should despite the production-oriented work environment and should give the consideration to acquire safety benefit (Arezes & Miguel, 2003) as cited in (Hee & Ping, 2014). Involvement of the government is significant to regularly improve health and safety conditions in work places and guarantee as less risky environment (Mazzolini, 2012). OSH training programmes are essential for the works to achieve organisation targets with reducing adverse effects (Connor, Flynn, Weinstock, & Zanoni, 2015).

Economics benefits are generated by improving the health and safety in the work place and positively affected for the factories and also for the whole society (Mansour, 2008) as cited in (Town et al., 2016). Health and safety complications in cement manufacturing industry can be controlled by preparing and implementing of safe operating and maintaining procedures, enforcing the safe operating procedures, maintaining safe conditions related to the safe working, giving considerations on environmental conditions, training the workers, providing periodic medical treatments, supervising on using personal protective equipment (Tomar, 2014). Improving management responsibility to supervise the workers about health and safety and management consideration on the health and safety in cement factory are most important

(Town et al., 2016). Risk engineering department in the cement factory involve to use risk engineering practices to control and eliminate risks associated with the cement manufacturing process (Town et al., 2016). Management practices for occupational health and safety are caused to continuously improve and manage the health and safety (Subhani, 2010). Local and government legislations should be followed by the organisation to minimize health and safety issues (Silva, 2011). The following section discusses the method of study adopted in this study.

#### RERSEARCH METHODOLOGY

Research methodology can be identified as the systematic way that can be used to achieve the aim and objectives of the research (Kotharri, 2004). This study was commenced with background study to identify the research problem and establish aim, objective, scope and limitation of the research. Then comprehensive literature survey was carried out by referring books, journal articles, and website to enlarge the existing knowledge on health and safety issues associated with the employees in the cement manufacturing and its effect on workers and society.

A qualitative method was followed in this research to achieve the research aim and objectives which allows the researcher to develop an in-depth analysis of a case, often a program, event, activity, process, or one or more individuals (Creswell, 2009). Mainly, opinions and justifications of interviewees were used for the research. In this study, three cases were limited to gather details regarding the research problem due to time constrains. Accordingly, three cases were selected in carrying out the research to fill the defined problem due to time constrains (refer Table 01).

**Table 23: Overview of selected cases**

Criteria	Case A	Case B	Case C
<b>Production categories</b>	Cement bags and bulk cement	Cement bags and bulk cement	Cement bags and bulk cement
<b>Number of total employees</b>	350	100	80
<b>Following national and international regulations</b>	Factory Ordinance, OSHAS 18001	Factory ordinance OSHAS 18001	Factory ordinance Own standards and regulations

In order to validate the literature findings with regards to Sri Lankan context, altogether twelve semi structured interviewees were conducted among the managerial level, supervisor level and labour level employees in the selected cases (refer Table 02). Further, the QSR.NVivo version 11.0 software which is the most common data analysis software for qualitative method was used to analyse the collected data in the research.

**Table 24: Profile of interviewee**

Case	Level of the interviewee	Designation	Experience (Years)
<b>A</b>	Manager	Health and Safety Manager (Plant, Quarry and project) - A1	17
		Health and Safety Manager – Training - A2	12
	Supervisor	Health and Safety engineer - A3	1
		Health and Safety Officer - A4	5
	Labour	Technician-Mechanical - A5	9
		Crusher Operator - A6	15
<b>B</b>	Manager	Health and Safety Manager - B1	3
	Supervisor	Electrical and Mechanical Supervisor - B2	9
	Labour	Technician – Quality control - B3	3
<b>C</b>	Manager	Health and Safety Manager - C1	10
	Supervisor	Packing Process Supervisor - C2	9
	Labour	Packing Machine Operator - C3	12

#### RESEARCH FINDINGS AND DISCUSSION

The findings from selected case studies were discussed under several sub-headings. This section covers the current practices to mitigate the causes of OSH issues, challenges for the enhancement of OSH practices and solutions to overcome those hindrances of enhancement and framework to enhance OSH practice in cement manufacturing industry. Those will be the basis for following discussion (refer Figure 01).



Figure 3: Stages of analysis

#### OSH Issues in Cement Manufacturing Industry

There are various types of occupational accidents and health diseases can be identified in the cement manufacturing industry. Most of physical accidents and work-related diseases have been disclosed in the literature synthesis and these issues were validated from interviews.

#### Physical accidents and injuries

Physical accidents and injuries are created in the cement manufacturing industry to the workers during their works thus lead to create direct and indirect financial and non-financial effects to the organisations. Following table 3 shows the main type of physical accidents and injuries occurred in Sri Lankan manufacturing industry.

Table 25: Physical accidents and injuries

Accident type	Details about the accident
Fatality accidents	Fatal accidents have been happened during raw material transportation by trains
Permanent disabilities	By heavy machine movement, operation of machine of rotating and moving parts, train operation, working at height
Loss time injuries	By machines with rotating and moving parts, using blasting materials in quarry, falling from height, heavy vehicle movement, excessive temperature and falling from high slopes and high walls in quarry area
First aid injuries	By all above causes, poor working environment including falls and trips, cutting and welding works



Based on literature survey and respondents' opinion during the data collection, physical accidents and injuries can be categorized as fatality accidents, permanent disabilities, loss time injuries and first aid injuries.

Result of empirical investigation, two fatal accidents have been reported in case A except other cases where the permanent disabilities were happened in all three cases due to heavy machine movement. In addition, first aid treatment injuries were frequent due to the careless of workers and the other hand, loss time injuries were recorded by all three cases due to the aforementioned causes (refer Table 3).

#### Health diseases

In addition to physical accidents and injuries, occurrence of health diseases are considered as major issue in the cement manufacturing industry. Even most of health disease were identified in the literature synthesis, all identified diseases could not find in the selected cases. Table 4 outlined the type of health issues addressed from the selected organisation and the roots behind those issues.

**Table 26: Health diseases**

Type of disease	Cause of disease
Eye problems	Exposure of cement dust
Breath problems	Exposure of cement dust
Caught	Exposure of cement dust and gasses emitted by blasting in quarries
Wheeze	Exposure of cement dust
Allergic	Exposure of cement dust
Headache	By excessive noise
Faint	By toxic chemicals
Skin problem	By toxic components in cement
Chest pain	By hard working
Swelling in legs	By long time working

Hearing difficulties	By excessive noise
Fatigue	By long time working

Result of research analysis, physical accidents, injuries and health diseases were highlighted as main issues in the cement manufacturing industry. The various types of causes which leading to create these OSH issues will be discussed further detailed following sections.

#### Causes Leading to Create OSH Issues

Basically, workplace hazards and organisational factors are core leading causes of OSH issues in the cement manufacturing industry. Following sections will be discussed those factors in detailed.

#### Workplace hazards

In cement manufacturing industry, identified various type of hazards which lead to cause OSH issues in the workplace by literature survey were validated through the empirical investigation thus will be clearly highlighted in Table 5 presented below.

**Table 27: Workplace hazards**

Type of hazard/ cause	Impact/ issue	Safety practices/ measures
Excessive cement dust	Respiratory problems and eye problems	<ul style="list-style-type: none"> <li>Annually measure dust level by the environment authority.</li> <li>Covering dust sources to reduce dust emission, use of dust masks and respirators, changing bag filters, use of dust collectors and sealing silos are the main safety practices to control effects from the dust.</li> </ul>
Excessive noise	Hearing difficulties and headaches due to the continue exposure of excessive noise for long time period	<ul style="list-style-type: none"> <li>Annually measure noise level by Environment Authority.</li> <li>Wear ear plugs during their works in high noise area and restrict the access of high noise areas except authorized people.</li> </ul>
Machines with rotating	Causes physical accidents i.e. first aid treatment injuries,	<ul style="list-style-type: none"> <li>Schedule the proper maintenance activities (ex: check the rotating and moving parts of machines).</li> <li>Use of PPEs, provide appropriate machine guarding, work instructions to control physical injuries.</li> </ul>

and moving parts	loss time injuries and permanent disabilities	
Vibration	Caused by heavy vehicle and heavy machine and it creates both human and property damages	<ul style="list-style-type: none"> <li>• Conduct routing inspections to identify excessive vibration.</li> <li>• It can be controlled by preventive maintenance activities and follow the user guidance for heavy machine operation.</li> </ul>
Dangerous atmosphere	Dangerous atmosphere with emission of Volatile Organic Compounds (VOC) create respiratory problem	<ul style="list-style-type: none"> <li>• Restrict to enter into the kiln area is considered as the safety practices. But, this is not highly considered in Sri Lankan cement industry.</li> </ul>
Toxic chemicals	Health diseases and accidents i.e. fatalities	<ul style="list-style-type: none"> <li>• Using PPEs, following Material Safety Data Sheets (MSDS), using qualified officers to handle chemicals are main safety practices.</li> </ul>
Fire	Damage both human and physical property	<ul style="list-style-type: none"> <li>• Conduct annual fire risk assessment.</li> <li>• Maintain proper fire protection and detection system.</li> <li>• Conduct fire drills and trainings twice per year.</li> </ul>
Electrocution	Fatality accidents	<ul style="list-style-type: none"> <li>• Conduct routing inspection and annual risk assessment to identify the electrocution.</li> <li>• Schedule the preventive maintenance activities, use of PPEs, indicate live electricity places, implement isolation and lockout system.</li> </ul>
Drowning	Physical injuries including first aid treatment injuries, loss time injuries and fatality accidents	<ul style="list-style-type: none"> <li>• Conduct routing inspections to identify the potential drowning hazards.</li> <li>• Restrict to enter to the quarry except authorized people and displaying precautions sign boards.</li> </ul>

High temperature	Physical injuries	<ul style="list-style-type: none"> <li>• Measure high temperature level in the operation process with respected to the standard level.</li> <li>• Use of PPEs and restrict to enter into the area where the temperature level is high.</li> </ul>
Radial hazards	It can be lead cancer and other physical illness after the long-time explosion	<ul style="list-style-type: none"> <li>• Less concern on this cause due to the lack of techniques to identify this hazard.</li> </ul>
Poor wok environment	Falls, trips and slips can be created injuries with medical treatment and loss time injuries	<ul style="list-style-type: none"> <li>• Conduct routing inspection.</li> <li>• Maintain proper housekeeping and regularly conduct housekeeping audits.</li> </ul>
Train operation	Fatal accidents and other injuries	<ul style="list-style-type: none"> <li>• Identify potential risks of the train movement via direct observation, complain from the own employees and public, annual risk assessment and past accidents reports.</li> <li>• As safety practices to control train accidents, Closed Circuit Television System (CCTV) is operated in the train engine and raw material transported area.</li> </ul>
Working at height	Physical injuries	<ul style="list-style-type: none"> <li>• Identify the potential risks by direct observation and routing inspections.</li> <li>• Use of PPEs and safety harness during the work at height.</li> </ul>
Heavy vehicle movement	Physical injuries	<ul style="list-style-type: none"> <li>• Identify the risk by routing inspections and referring past records.</li> <li>• As safety practices, all vehicle drivers are trained by the outside trainers who having experience on field.</li> </ul>
Blasting materials	Physical accidents, eye problems and hearing issues can be caused	<ul style="list-style-type: none"> <li>• Use of PPEs by quarry workers and restrict to enter into quarry area.</li> </ul>
High walls with high slopes and open edges	Physical accidents i.e. first aid treatment injuries and loss time injuries	<ul style="list-style-type: none"> <li>• Identify the risk by routing inspections and referring past records.</li> <li>• Use of appropriate PPEs and sign boards.</li> </ul>

Aforementioned (refer table 5) causes, impacts and safety measures were validated in the research finding and analysis phase based on the opinions of respondents from the selected cases.

#### Organisational factors

Followings are organisational factors which are leading to cause OSH issues in cement manufacturing industry (refer Table 06). The below Table 6 presented the summary of organisational factors and how they are influenced to cause the OSH issues based on the empirical finding and analysis.

**Table 28: Organisational factors**

<b>Organisational factor</b>	<b>Description</b>
Lack of experience and knowledge	Most of contract employees in the industry, they are changing and new employees are coming, it is difficult to retain experience workers within the factory. This has been reason to create OSH issues in the factory
Poor working relationship among workers	Some employees do not like to build relationship among them due to their personal bad attitudes.
Careless activities of workers	Some employees think that they are over confidence and try to work without care. In such situation accidents can be happened. And also, workers bypass the safe work procedures.
Urgent operational activities	In sudden breakdowns and immediate maintenance requirements, workers have to perform their tasks within a short period and they try to bypass safe work procedures.
Lack of awareness of worker's responsibilities	Workers neglect their responsibilities without taking accountability of their tasks and not fully aware about the tasks and accidents can be happened.

Lack of resources to support for health and safety	Financial resources and difficulties to find out skilled and confident employees.
Inadequate strategies related to the health and safety	Inadequate strategies to ensure safety of customers and other outside parties.
Lack of awareness of perspectives related to the OSH	New comers and contract employees are not fully aware about the OSH.
Lack of information related to the OSH	Lack of information about the machine operation procedures, maintenance procedures, safety working procedures and chemical using procedures are caused to create OSH issues
Lack of supervision of the employees	Some supervisors are neglect their responsibilities and adequately not provide their supervision to their labours. An adequate supervision is not received in night shifts period.
Risky attitudes and behaviors of workers in the workplace	Due to overconfidence, employees like to get unnecessary risks during their jobs. This causes OSH accidents during their works.
Lack of use of PPEs by workers	PPEs are not properly used by the workers during their works and this can be identified as a bad behavior of workers.
Providing defective PPEs to the workers in the factory	Contract employees are received PPEs from their mother companies and these PPEs are consisting with some defectives.
Equipment in the workplace are not properly used by workers	Even there is an enough knowledge and experience to use equipment and machines in the work place, these are not properly used in workplaces by workers thus leading accidents.

As the result of research analysis, lack of experience and knowledge, lack of resources to support the OSH, risky attitudes and behaviours of workers in the work place, and lack of the use of PPEs by workers were exposed as the major causes of OSH issues in manufacturing industry. In addition, **urgent operational activities**, equipment in the

workplace are not properly used by the workers, and lack of supervision of the employees were disclosed as considerable causes of OSH issues in the manufacturing industry. Though, lack of supervision of employees addressed as considerable cause of OSH issues by majority of respondents, all the supervisory level respondents neglect to accept it as a cause of OSH issue because they **always provide adequate supervision to the employees.**

#### Current Practices with regard to Mitigation of Causes

Cement manufacturing industry is a numerous kind of risk included industry and always exposure to the occupational accidents and health diseases. By implementing proper safety practices, these adverse effects can be minimized. As per research investigation, plenty of safety practices are followed to improve the occupational safety and health of the employees in Sri Lankan cement manufacturing industry (refer Table 7).

**Table 29: Current Practices with regard to mitigation of causes**

<b>Current Practices</b>	<b>Details about the practice</b>
Following the National and International legislations and standards	Following the conditions in the Factory Ordinance and Occupational Safety and Health Assessment System (OSHAS) 18001:2007
Safety training	Safety trainings are conducted to cover all safety requirements
Safety reporting and recording system	There are manual and online safety reporting and recording system
Safety policies and procedures	Organisations have special safety policies and procedures and these are continuously updating
Safety monitoring system	Work activities and related work procedures are continuously monitored and evaluated to keep the safety among workers at standard level
Key performance indicator system	It is considered as the safety and health is a Key Performance Indicator (KPI). Safety KPI is engaged with the employee's salary and bonus.
Safety meetings and awareness programs	In safety meetings, safety related information is discussed and take appropriate decisions for the improvement of OSH. Safety awareness programs are implemented before starting every work.

## Challenges Associated with Enhancement of OSH in Cement Manufacturing Industry in Sri Lanka

Even though, plenty of activities have taken place to ensure OSH in workplace, there are some factors which have become the challenge in applying and enhancing OSH practices in cement manufacturing industry. Based on the empirical finding, six challenges for the enhancement of OSH practices and solutions to overcome those hinders of enhancement were projected (refer Table 8).

**Table 30: Challenges associated with enhancement of OSH**

<b>Current Practices</b>	<b>Description</b>
Fund limitation	Since safety is considered as a KPI, enough finance resources should be allocated. Enough finance should be allocated to obtain national and international standards for OSH
Ensuring safety of contract employees	Provide induction programs to aware about OSH, introduce safety rewarding systems to encourage them and penalty system to mitigate defaults
Lack of confidence of employees	Allocating suitable tasks to the employees that can be fulfilled by them, Upgrade the confidence by providing training and other special programs
Unrealistic production targets	Managers should forecast future demand and prepare job schedules and informed to others also
Ensuring safety of customers and other outside parties	Providing information and instructions about the OSH and providing PPEs to the customers and other outside parties.
Negligence of safe work instructions by employees	Providing necessary trainings and suitable programs, encouraging the employees about OSH by sharing past experience and knowledge with them. Introducing safety related penalty system.

## Proposed Framework for Enhancing OSH in Cement Manufacturing Industry

A framework was developed finally incorporating findings of the study which will facilitate the safety practices to mitigate current OSH issues in Sri Lankan cement manufacturing industry. Figure 02 shows the developed framework which can be used as a safety tool for all practitioners to enhance the OSH practices in Sri Lankan cement manufacturing industry.



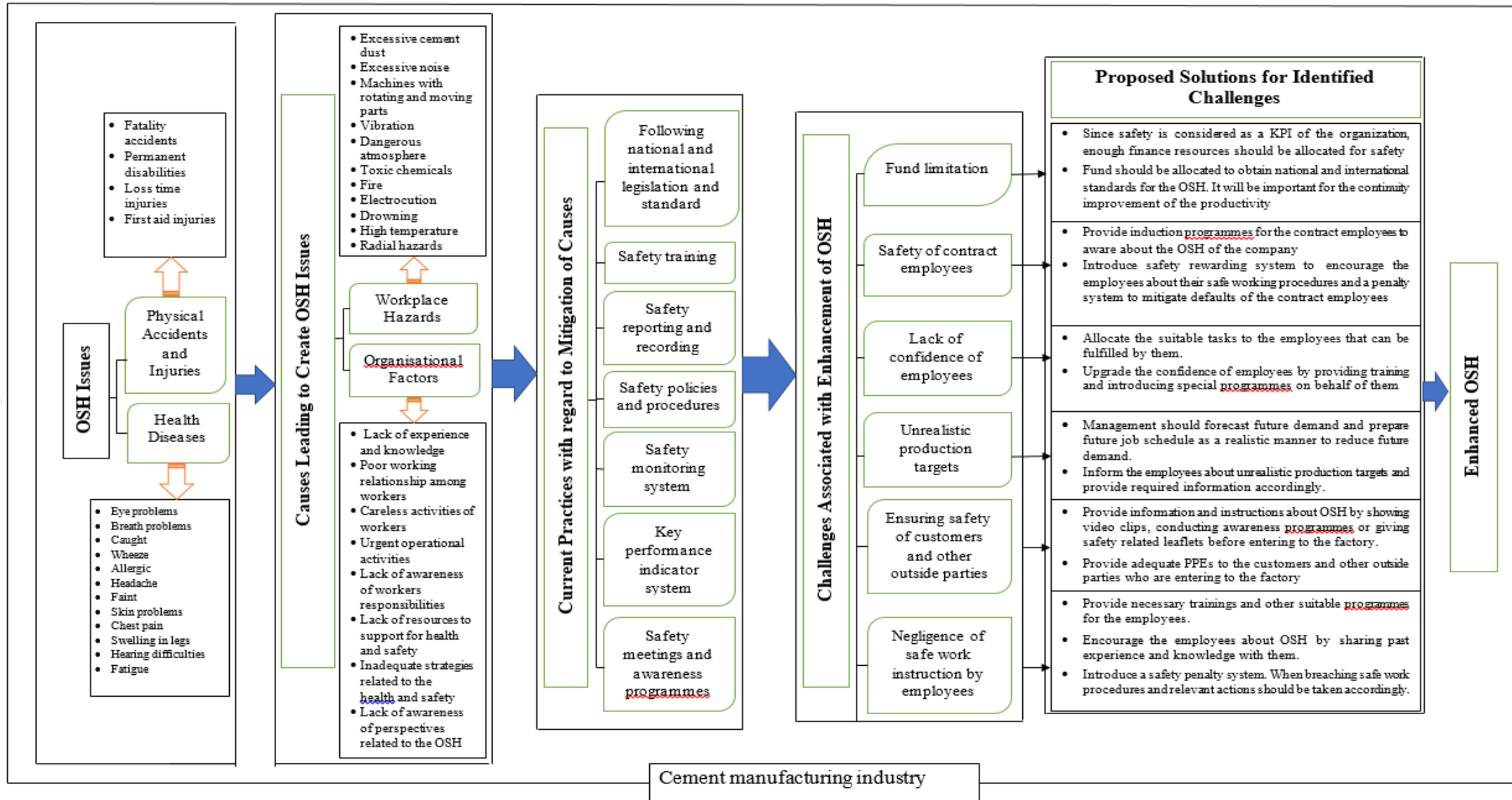


Figure 4: Proposed framework to enhance the OSH in cement manufacturing industry

## CONCLUSIONS

Occupational Safety and Health (OSH) as the science and art of the anticipating, recognizing, analysing and monitoring of hazards arising in the workplace that could harm the health and well-being of employees. Though the practice of OSH is increases over the world, very few research only conducted on the subject area. Therefore, this study is focused to develop a framework for enhancing OSH in cement manufacturing industry in Sri Lanka. This research study emphasis the necessity of OSH practices in cement manufacturing industry.

In this study, OSH related issues have been categorized into two broad type i.e. physical injuries and health disease. Further the causes behind those issues also classified into two including workplace hazards and organisational factors. Altogether seventeen (17) workplace hazards and its impacts and safety measures to overcome those hazards and fourteen (14) organisational factors and its impacts were validated. Among fourteen (14) organisational factors, lack of experience and knowledge, lack of resources to support the OSH, risky attitudes and behaviours of workers in the work place, and lack of the use of PPEs by workers were disclosed as the major causes of OSH issues in manufacturing industry. In addition, seven (7) safety practices to mitigate the OSH issues and six(6) challenges for the enhancement of OSH practices and solutions to overcome those hinders of enhancement were projected. Finally, a framework was developed based on the findings to facilitate the safety practices to mitigate OSH issues in Sri Lankan cement manufacturing industry.

## REFERANCES

- Alli, B. (2008). Fundamental principles of occupational health and safety. *Vasa*.  
<https://doi.org/10.1017/CBO9781107415924.004>
- Aminian, O., Aslani, M., & Sadeghniaat Haghighi, K. (2014). Cross-shift study of acute respiratory effects in cement production workers. *Acta Medica Iranica*, 52(12), 146-152.
- Banyen , S. (2016). Effects of Work Pressure on Employee Safety Behavior in the Construction Industry in Ghana.
- Central Bank Annual Report*. (2015). Retrieved from Central Bank Annual Report.
- Connor, T., Flynn, M., Weinstock, D., & Zaroni, J. (2015). Training for Underserved Populations. 24(1), 1-20.  
<https://doi.org/10.2190/NS.24.1>.
- Creswell, J.W. (2009). *Research design: Qualitative, quantitative, and mixed method approaches* (3rd ed.). Los Angeles: SAGE Publications.
- Franklin, M. (2015). Extent of the Implementation of the Occupational Safety and Health Act 2007 in the Sarova Group of Hotels in Nairobi.
- Hamalainen, P., Takala, J., & Saarela, K. (2006). Global estimates of occupational accidents. *Safety Science*, 44(2), 137-156.  
<https://doi.org/10.1016/j.ssci>

- Hee, O., & Ping, L. (2014). Organisational Culture and Safety Performance in the Manufacturing Companies in Malaysia: A Conceptual Analysis. *4*(1), 99-107. <https://doi.org/10.6007//IJARBSS/v4-i1/516>
- Hokoma, R., Khan, M., & Hussain, K. (2008). Investigation into the implementation stages of manufacturing and quality techniques and philosophies within the Libyan cement industry.
- International Labour Organisation*. (2016). Retrieved from International Labour Organisation.
- Kotharri, C., (2004). *Research Methodology Methods and Techniques* (2nd ed.). Jaipur: New Age International.
- Lokugamage, A. (2016). *Tokyo Cement Company (Lanka) Plc*.
- Mazzolini, G. (2012). The economic consequences of accidents at work. 1-33.
- Mikul, H. (2016). Reducing greenhouse gas emissions by fostering the deployment of alternative raw materials and energy sources in the cleaner cement manufacturing process. 136. <https://doi.org/10.1016/j.jclepro>
- Mounia, T., Rachid, C., & Yahyia, C. (2017). Promoting a culture of health and safety at work in cement plants. *International Journal of Computational Engineering Research*, *2*(8), 318-321.
- Rachid, C., Ion, V., Irina, C., & Mohamed, B. (2015). Preserving and improving the safety and health at work: Case of Hamma Bouziane cement plant (Algeria). *Safety Science*, 145-150. <https://doi.org/10.1016/j.ssci>.
- Sana, S., Bhat, G., & Balkhi, H. (2013). Health Risks Associated with Workers in Cement Factories. *International Journal of Science and Reserach Publications*, *3*(1), 2250-3153.
- Silva, N. (2011). *Occupational Safety, Health & HIV - AIDS in Sri Lanka, 2011*.
- Subhani, M. (2010). *Study of Occupatioanl Health & Safety Management System (OHSMS) in Universities' Context and Possibilities for its Implementation: A case study of University of Gavle, (June)*.
- Tomar, M. (2014). Study of Occupational Health, Safety and Environmental. *Journal of Enviornment and Earth Science*, *4*(9), 117-120.
- Town, C., Victor, S., Atsango, A., Solomon, O., & Africa, S. (2016). Identifying Hazards Facing Workers in Cement. 367-375.
- WBCSO. (2004). Health and safety in cement industry: Exmple of good practice. 87.
- Western Australia, G. (2005). General duty of care in Western Australian workplaces.
- WHO. (2001). Occupational Health: A manual for primary health care workers. *World health organisation*, 173. [https://doi.org/10.1007/SpringerReference\\_300993](https://doi.org/10.1007/SpringerReference_300993)