BEHAVIOR BASED APPROACH FOR ENHANCING SAFETY IN PRINTING INDUSTRY: CASE STUDY APPROACH

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Thesis submitted in partial fulfilment of the requirements for the degree Master of Science in Occupational Safety and Health Management

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CANDIDATE'S DECLARATION

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The above candidate has carried out research for the Master's thesis under my supervision.

Name of the Supervisor: Dr. Nayanathara de Silva

…… ……

Signature of the Supervisor Date

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I would like to convey my sincere gratitude to all the individuals I came across during my research work for their whole hearted assistance, encouragement and guidance discharged to me in the great feat of completing the research.

First and foremost, I am greatly indebted Dr. Nayanathara De Silva, supervisor of my research and the course coordinator of MSc Health and Safety Management courses for extended her kind co-operation, guidance and directing me in completing this thesis successfully.

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Last but not the least; I express my wholehearted gratitude to my family for supporting me during writing this thesis and throughout my life.

ABSTRACT

In Sri Lanka today, the requirement of printing industry grows upward in speedily since they are contributing to provide a range of products to the market both local and export such as papers, books, security printed papers, cartoons, garment tags, labels etc. However it needs to be pointed out the reporting of industrial accidents also are increasing year by year. It is same to the printing industry. As per the experts' view 90 % of accidents occur due to human errors. Unsafe human activities are leading to cause server accidents in the printing industry and directly impact to their production.

Workplace accidents are the result of employees' negligence or employees' lack of care. Employees together with employers have a vital responsibility to prevent industrial accidents and injuries. It should be provide significant weight to occupational safety and health, improve human behaviour in order to mitigate accidents by preventive measures, and ensure that employees have the required information, training, and supervision to carry out their jobs safely. The aiming is this study to use Behaviour Based Safety (BBS) approaches to prevent workplace accidents in the printing industry. A case study was performed with selected two large scale annual production printing plants located in the Biyagama Export processing Zone. Based on the prepared questioners semi structured interviews and expert survey were conducted with reviewing accident analysis reports to gather information and data validation.

The results pointed out the factors affecting to unsafe behaviours of employees. According to the workers judgments and root cause review of accident analysing reports, factors such as lack of safety related trainings, lack of worker involvement for safety, lack of management commitment to improve safety culture, inefficient communication system are directly link to improve worker unsafe behaviours and report accidents. Experts validated that approaches of each behavioural factors to reduce accidents in printing industry. The final outcome of this study is helping to improve employee moral towards safety and reduce accidents while improving productivity.

Key words: types of accidents, unsafe behaviours, behaviour based safety, behaviour based safety factors

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ABBREVIATIONS

USA	**U**nited **S**tates of **A**merica
BB	**B**ehaviour **B**ased
BBS	**B**ehaviour **B**ased **S**afety
HSE	**H**ealth & **S**afety **E**xecutive
HSE	**H**ealth **S**afety & **E**nvironment
EHS	**E**nvironmental **H**ealth & **S**afety
RIDDOR	**R**eporting of Injuries, **D**iseases and **D**angerous **O**ccurrences **R**egulations
SOP	**S**tandard **O**peration **P**rocedures
WI	**W**ork **I**nstructions

CHAPTER 01

BACKGROUND

1.1 Introduction

In recent years, reporting of workplace accidents became worse and it was one of the major concerns of organizations involved to find solutions. Workplace accidents have been occurred for number of reasons. Jitwasinkul & Hadikusumo (2011) stated to identify the root cause of industrial accidents. Several research workers have done numerous researches and build up systematic system for safety and technical solutions to minimize accidents as well as injuries at the place of work. During this process of reduce accidents, the main task was to identify reasons for reported accidents. It was founded that either unsafe act/human behaviors or unsafe working conditions as main factors to report accidents in any workplace. Among those identified two main causes, it was cleared that human behaviors are the prominent reason to cause industrial accidents. Jitwasinkul & Hadikusumo (2011) also mentioned that people are tone of the prime cause for problems of workplace accidents and injuries.

According to Vagner (2017) Printing industry also created various types of hazards including physical and health, specially when those working employees are not giving their concentration to what they do or not capable to do the task. Johnson, Nyador & Agbenorku, (2010) also added their comments as most of printing industries' Health & Safety (H&S) arrangements are questionable. Even they did not allocate separate H&S manager to take responsibilities for H &S matters. Only they allocated first aider to manage incidents. According to the Johnson et.al (2010) printing process were made several hazards or potential health issues to their workers. As per the Vagner (2017) accidents are happen due to employees' lack of care to their task as make adjustments or preparing machine while running or doing adjustment without locking the machine, unauthorized access to tools and machine accessories etc.

These days large arrangement of work place accidents were also caused by personal causes. Woods, Johannesen, & Dekker (2010) detected that basically human error was one of the main reason for report accident and injuries in most of organizations. The mentioned researchers; Woods, Johannesen, & Dekker (2010) strongly opined that the label "human error" was prejudicial and unspecific, and leaded to system failure and in turn leads to accident.

Sadullah, & Kanten (2009) generally accepted that the majority of workplace accidents occured as a consequence of the unsafe behaviors of employees. Chen & Tian (2012) have mentioned that based on the Heinrich identified 75,000 of work related injuries mean 88% of industrial accidents were reported because of employees' unsafe behaviors. Further they have mentioned that Heinrich's observational findings specified that facilitating through controls within humans it can reduced up to 98% work related accidents. As per Mohammadfam, Ghasemi, Kalatpour, & Moghimbeigi, (2017) still unsafe behavior viewed as the key factor to report workplace accidents in various industries especially in developing countries. For that reason, it has become a vital debatable topic to put off and manage individuals' conduct for the purpose of prevention of work related accidents.

Worker safe acts could be mentioned as an acceptable tool to prevent occupational accidents and injuries. Behavioral safety was the use of behavioral psychology to promote safety and involved to create a systematic ongoing process that determine significant behaviors to reduce the risk of work related accidents (Lee, Lee & Lim, 2011).

Julia Clancy Qest Consulting Group (2010) have mentioned that Behavior-Based Safety (BBS) approaches have become a popular technique which can be used to manage people side of safety. This approach was originally formed in USA. It was presented the methods of motivates and reinforce human behaviors. Fundamentally it was identified that the rewards for behaving unsafely often be more important than the rewards for safe behaviors.

Cooper (2009) said that behavioral safety has many supportive and many critics. In reality, similar to the other safety management interventions, the method of behavioral safety necessitates a concentrated attempt from everyone to make positive results. The objective of a behavioral safety process was to reduce accidents and incidents prompted by unsafe or at –risk behaviors. To achieve the objectives, it should be identified specific behavioral issues by monitoring on incidents that resulted from the dealings with people and their working environment. Once those issues were selected, efforts were made to find out which antecedents were driving at-risk behavior, and which consequences were reinforcing or keeping up that behavior so that suitable corrective measures could be in used.

Carrying out the change strategy usually engaged to deal with the environment to eliminate obstructions while the associated safety behaviors were implemented on checklists thus employees could carry out inspections of behaviors. The outcomes of the review pointed out that the plan of the behavioral safety process was as essential as the psychology of behavioral safety term (Cameron & Duff, 2007; Cooper, 2006a; 2006b). Further authors pointed out that clear evaluating human behavior and providing adequate measures were not sufficient to keep accident reduction. Implementing daily inspection walks, focusing on workgroups and use participative targets with their feedbacks helped to reduce accidents effectively. It should be received adequate management support to employees to behave safely and take maximum benefits of human behavioral safety. Fulfilling the statement, Cameron & Duff (2007), Cooper (2006a; 2006b) mentioned that strong management commitment is essential to deliver behavioral safety and get maximum support.

Recent time the concept of BBS was introduced and practiced by worldwide to get maximum benefits and now this was a most popular method of reducing accident in workplace which were most industries use. Various publications provided in detailed information including implementation elements, steps etc of BBS (Geller & Williams, 2001). Further some of researchers have shared believable proof information of successfully applying of BBS to various industries as a tool to reduce accidents under various publications as described later through later chapters.

1.2 Problem statement

Recent years though have implementing various types of procedures protocols, industrial accident rapidly increase. This was one of the major issues of practicing un- behavioral safety practices with in the workplace within their task carried on. Even though have provided good practices of training the culture of practicing bad behavior of health safety and environment was same with the organization. It was directly leading to happening accidents injuries to the operators/ workers in the industry.

This topic was significant nowadays with observed records of accidents. hence it should be addressed effectively to find out the common BBS program have in commonly use to the industry with the necessary components especially in the printing industry. Since with compared to the other industries it was highlighted that various accidents have been seen in printing industry and the root cause results were the behavioral issue to the safety practices.

In the past most of industries put their effort to step up their safety conducts and culture with adjusting the working environment of workers (Nielsen, 2013). Although industries have caught huge achievement of impending the strategy to the industry specially providing hazard free environment and the ergonomically well establish work place to the employees with the worker friendly tools. Injuries continuously occurred due to the human errors, people doing mistakes and at the risk behaviors have encourage in the work group.

The situation was similar in the printing industry also Vagner (2017). Printing industry could be named as one of hazardous workplace which is large number of machineries and hazardous substances used Johnson, Nyador & Agbenorku, (2010). Reporting of number accident in printing industry was also in augment due to human errors Vagner (2017). Hence this study was focused to review how BBS can be used to printing industry to reduce workplace physical accidents. Consequently this research mainly consisted with enhance safety in printing industry while using Behaviour Based (BB) approach. The study focused to point out and illustrate required aspects to address for implementing BBS system to the printing industry.

1.3 Aims and objectives

The aim of research is to use BB approach to enhance safety in printing industry. Here with formed objectives which can be used to achieve the research objective?

1. Identify types of accidents in printing industry and causes for unsafe behaviours to cause accidents
2. Identifying the concept of BBS
3. Analyze behavioural factors to cause accidents in printing industry and to suggest recommendations to reduce accidents

1.4 Research methodology

A broad literature review conducted by referring books, journals, research articles and other publication to identify the concept of Behaviour Base Safety, different approaches of behaviour base Safety, advantages and disadvantages of Behaviour base Safety to approaching reduce accidents and factors affecting to increase industrial accidents.

Case Study method adapted in to research study which facilitating in depth study for identifying closer factors to increase accidents in printing industry which is support to unsafe behaviour, and how can implement build up safe behavioural culture to reduce industrial accidents.

Two cases were carried out to examine mainly by conducting semi structured interviews among printers and other core business departments such as finishing and engineering in selected large two printing factories who are contributed large scale production to identifying causes for unsafe behaviours, its related accidents and the way should printing industry address those factors to implement safe behaviours to reduce accidents.

1.5 Scope & limitations

The scope of this research was to use behaviour based approach to enhance safety in printing industry. However there were few limitations also could be formulated here as mentioned below;

1. Due to lack of accessibility of large number of printing industries, researcher decided to select two printing companies. These case studies were carried out within large scale which is more than 250 employees in the factory and it was limited only to private sector factories located in Biyagama Export Processing Zone.
2. One of limitation could be mentioned here as the outcome of the study is mainly developed upon people judgement and selected organizational records.
3. Another highlighted limitation is to point out that this research mainly focused only for physical accidents and injuries. Printing industry related occupational health issues were not described due to lack of information available in printing industry.
4. The other important point was the difficulty to find out literature related to Sri Lankan context, as all accessible literature was from other countries.
5. Another limitation could be mentioned here as cultural background towards safety is minimal. Lacks of legislations, guidelines were supported to cause unsafe behaviours to people.

1.6 Chapter breakdown

Figure 1.1 illustrated how the chapters had been arranged throughout this dissertation in details.

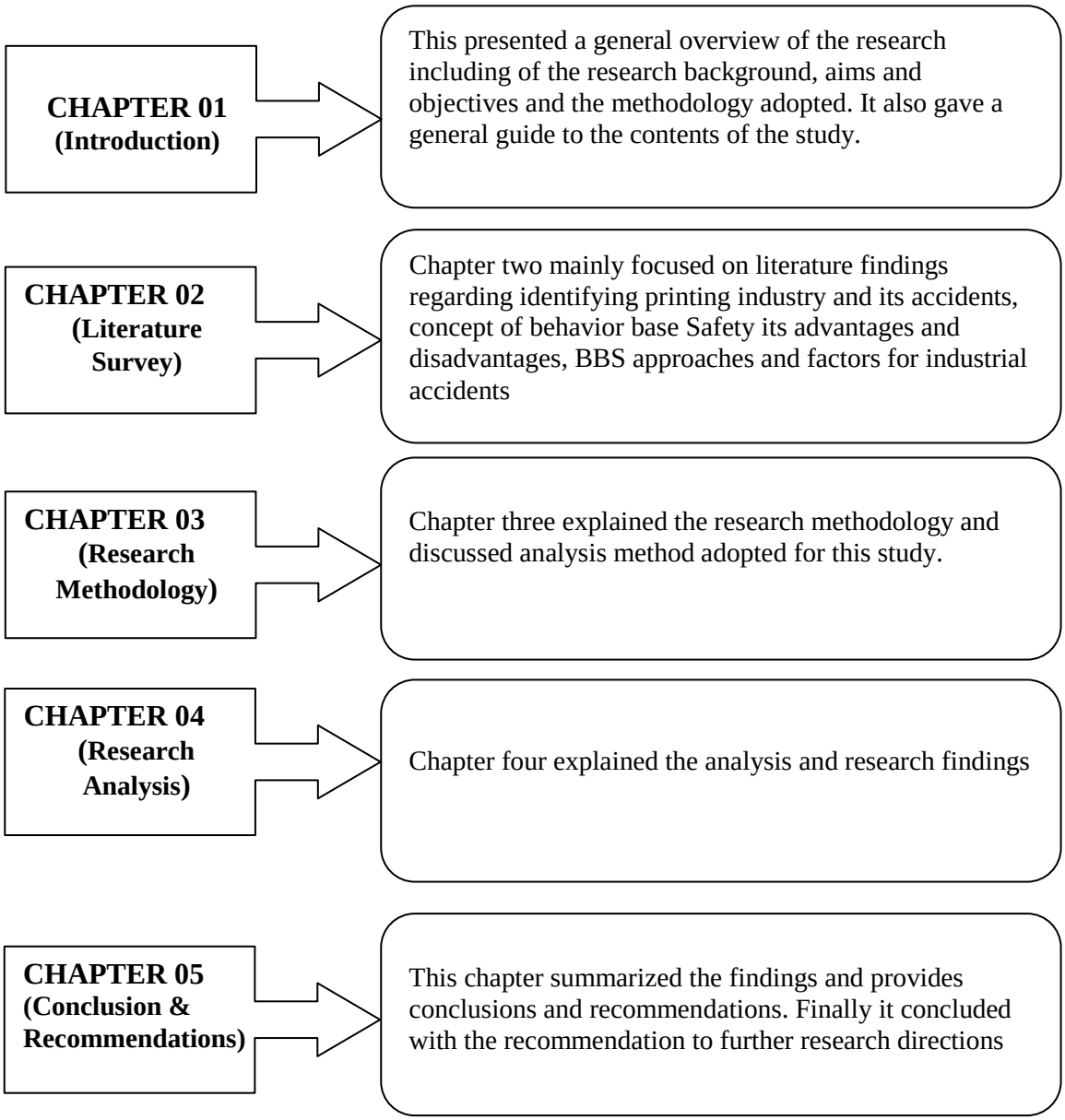

Figure 1: 1 Chapter Breakdown

1.7 Chapter summary

The main task of this chapter was to emphasize the background knowledge on the research area and forming the research problem which base to this research. Further it described aims and objectives methodology, scope and limitations. At the last it showed the total structure of this research. Main objective was to formulate as behavior based approach to enhance safety in printing industry. Thus, main three objectives have been formulated to achieve the set aim.

CHAPTER 02

LITERATURE SURVEY

2.1 Introduction

Behaviour Based Safety (BBS) as identified one of the best tool focused on modifying individual activities to create risk free environment to work. Effectively addressing to human errors and encouraging employees towards safety culture will lead to enhance employee motivation for work.

This chapter reviewed the literature on types of physical accidents in printing industry, unsafe behaviour and their contributory factors for accidents. Further this chapter is demonstrating the concept of BBS.

2.2 Review of Printing Industry

Printing was an omnipresent combined with our day today life, starting from the printing of personal related documents, to documents which are using to connect in industry and the producing of large scale output of books, magazine, paper, bank notes advertisements etc. (Bousquin, Esterman & Rothenberg, 2011).

Paper and textile printing industries are an important industry in Sri Lankan sector which are contributed more to the national income. Decharat (2014) mentioned that the printing industry is composed of different types of business units. Almost everything that has print on it has come in to contact with some sort of printing industries. According to the Decharat (2014), "printing process can be divided in to three major steps: Pre Press, Press and Post Press". Pre Press can be illustrated as all pre planned works after the order confirmed by the customer called as Pre Press work such as artwork/ graphic designing, design assembling, colour matching, ink preparation, formula creation etc. Press means the actual printing operation. Press refers to the actual printing according the information, process received from the Pre Press. Post press mainly involves the assembly of printed materials and consists of binding and final operations.

2.3 Accidents in Printing Industry and their causes

2.3.1 Accidents in Printing Industry

Yilmaz, Sevindik & Akpolat (2015) mentioned that with the development of the industrial sector the new concept of occupational life found in place. However occupational accidents/ injuries and diseases began to increase correspondently. Production process in factories and other work sites also began to affect the workers physical and psychological manners. These negative effects first appeared across in countries in where industrial revolution began.

According to the Health and Safety Executives (2011) 560 accidents reported under the Reporting of Injuries, Diseases and Dangerous Occurrences Regulations (RIDDOR) during 2009-2010 in the printing industry. As shown in figure 2.1, Manual handling, slips trips and machinery related accidents presented for more than 70 % of these and 40 % of main and common accidents were the results of Slip/Trips.

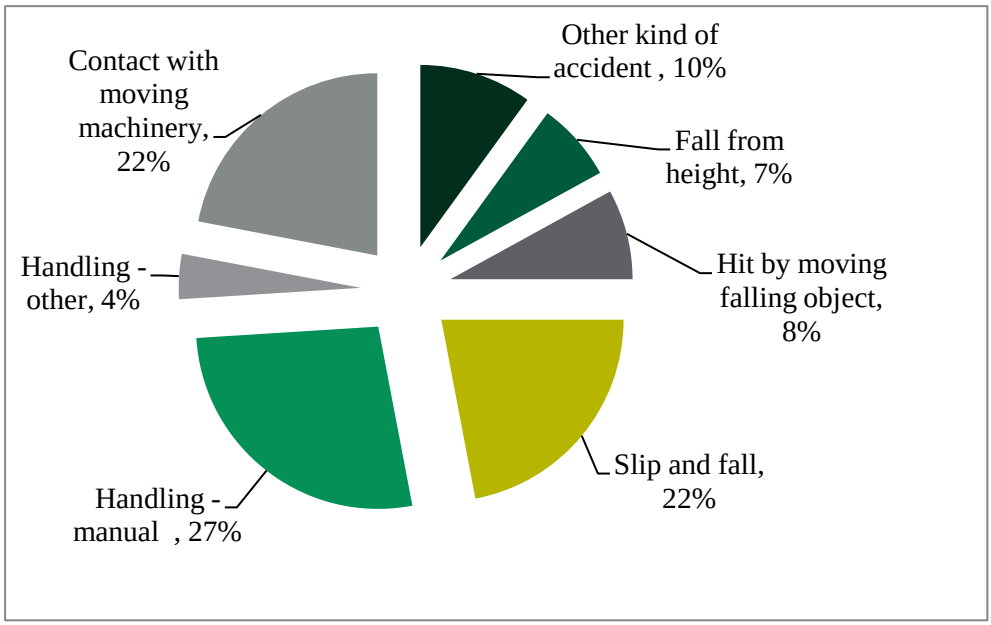

Figure 2: 1 Causes of RIDDOR Accidents 2009 – 10 (Provisional) Source:

(http://www.hse.gov.uk/printing/statistics.htm)

Hung et.al (as cited in Agbenorku, Johnson, Nyador, & Agbenorku,2010) raised that printing operations and its related process can be presented various of hazards or potential health issues to their workplace workers. Further the author illustrated examples to printing industrial hazards. Proving of Hung et.al statement, Agbenorku et.al (2010) exemplified as cuts, bruises, abrasions are the most common nature of injuries in printing industry. Based on the Health & Safety Executive – HSE[1] (2002) mentioned that cuts, strains and pinch injuries are the most common type accidents in the printing industry.

Lacerations, superficial (i.e. cuts and bruises), and fractures or dislocations were the most frequently reported type of accident as illustrated in figure 2.2. These findings are dependable due to frequency of manual handling work, involved in the Printing and Publishing industry, where hands are use in closer proximity to moving parts of the printing machines. Further the author mentioned that majority of accidents are happened by the time of intervention, most commonly during releasing blockages in the machine. This is actively happen during the cleaning and webbing – up doing make ready machine to production.

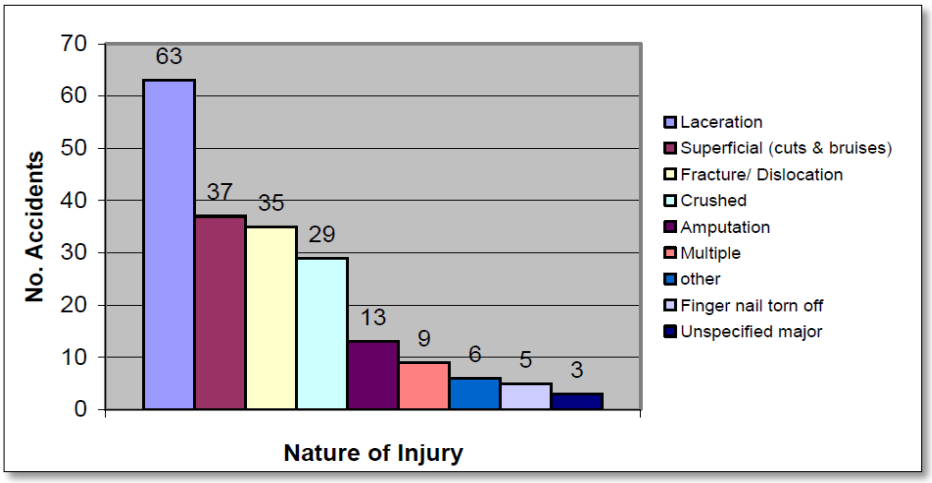

Figure 2: 2 Nature of injuries in the sample (n=200)

Source: Analysis of RIDDOR Machinery Accidents in the UK Printing and Publishing Industries 2003-2004

Scott (2004) mentioned that there were 341 injuries have been caused by slips and trips in between 2002, 2003 and the from UK Printing and publishing industries. In the printing industry, slip trips and falls are the second most common on causes or reportable injuries and the primary causes of injury being unsafe manual handling issues. Bases on the Scott (2004) analysis report the majority of injuries were caused by slips and trips. Slips caused 41% of falls and trips caused 34% as figure out in below figure (2.3)

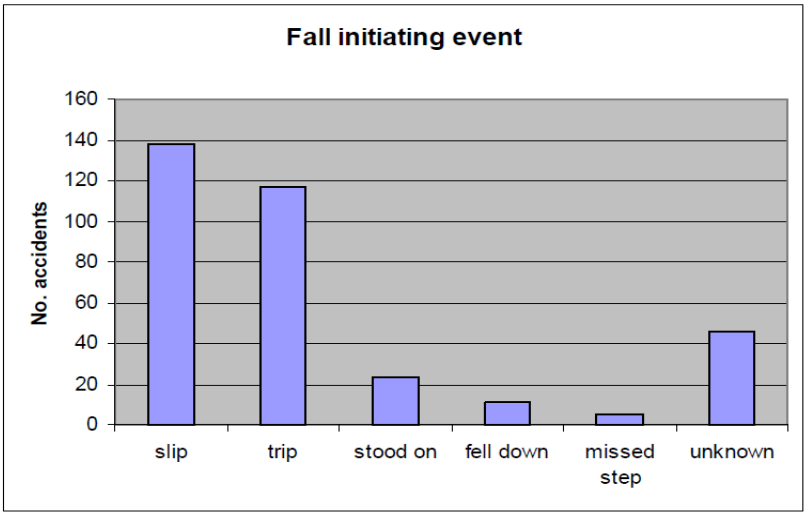

Figure 2: 3 Fall initiating events

Source: Scott (2004) Analysis of Slips, Trips and falls in the UK Printing and Publishing Industries, 2002-2003

Yilmaz, et al. (2015) figured out that based on the several studies and statistical verifying, the main risk factor of printing and publishing sector are : manual handling, moving machines, fallings, being hit by objects, hazardous chemicals, non ergonomic working environment and work related stress.

According to the information gathered via literature survey relating to the types of accidents in printing industry could be summarized as showed in table 2.1. Based on the several research publications discussed above, majority of accidents have been reported due to slips and fall, trips and fall, unsafe manual handlings.

Table 2: 1 Types of accidents in printing in printing industry

Common types of accidents in printing industry	1. Slips and fall 2. Trips and fall 3. Chemical related accidents - chemical splash and contact in to body parts - chemical spillages 4. Machinery related accidents - Laceration - Cuts and bruises - Fractures / dislocation - Crushed - Amputation - Finger nail torn off 5. Fallen down from height 6. Ergonomic issues due to unsafe manual handlings 7. Hit by moving falling objects

2.3.2 Causes of accidents in Printing Industry

No of causes could be highlighted as root causes for accidents in printing industry. Healey (2006) pointed out that accidents happened because of the contacting with moving parts are one of the most common reasons of accidents happen to their workers in the printing industries. According to the figure 2.4, highest primary cause is mentioned as rollers in-running nip (35%), due to get in touch with movable elements (32%) and then entanglement with rotating parts (11%). As mentioned by World Bank group (2007) the root causes of fire hazards in pressrooms in printing industry due to friction, static electricity and sparks. Based on the Scott (2004) findings, it could be analyzed as causes of falls in printing industry were poor

housekeeping, poor maintenance and weather condition, working environmental condition such as wet condition on the floor, unsafe arrangements on the floor level.

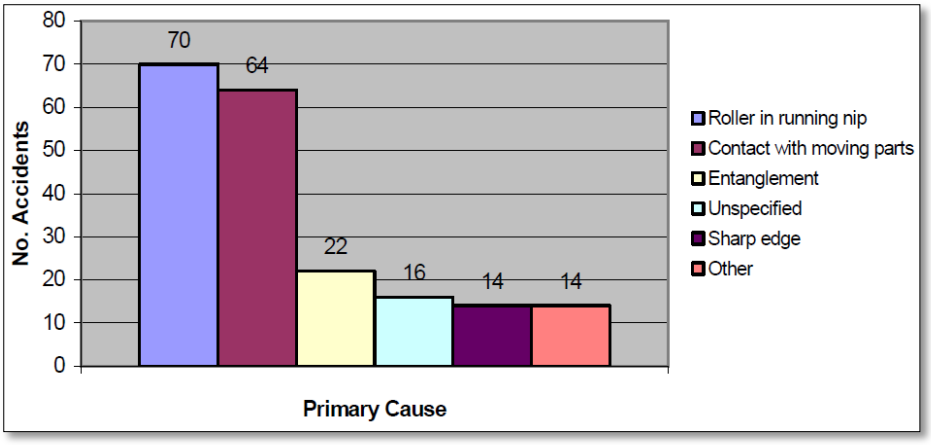

Figure 2: 4 Primary causes of all injuries in the sample (n=200)

Source: Analysis of RIDDOR Machinery Accidents in the UK Printing and Publishing Industries 2003-2004

2.4 Unsafe Behaviours of workers/ employees

Work related accidents occur either as a results of lack of awareness, poor training facilities, lack of administration and availability of poor procedures. Additionally, a human error is leading to cause carelessness, lack of care of workers, irresponsibility of workers and lack of monitoring and controls (Khdair, 2011). Myers (as cited in Byrd, 2007) made present that is difficult to control, around 80 to 95 percent of all accidents are caused due to unsafe behaviors. Famet al., (2012 as cited Mohammadfam, Ghasemi, Kalatpour & Moghimbeigi 2016) have been voiced as any behavior engaged in by an employee devoid of following safety rules and policies including implemented best practices in the system that can be adversely affect the safety management system or cause dangers to workers themselves or their colleagues.

The concept of unsafe behavior was introduced by Abdelhamid and Everett (2000 as cited in Mohammadfam, Ghasemi, Kalatpour & Moghimbeigi 2016) as one of the

major causes of accidents have occurred at constructions sites. Haslam et al., (2005 as cited Mohammadfam, Ghasemi, Kalatpour &Moghimbeigi 2016) demonstrated that employees or team of employees are a key factor as many as 70 % of accidents in construction industry.

Unsafe behavior has attached more attentions in recently and most of organizations have more and more applied the method as a measure of safety performance within their business unit. Behavior Based Safety Management has been initiated in this regards, aiming at improving overall safety performances of an organization by enhancing safety behaviors of their workforce (Coudhry, 2014 as cited in Famet et el; Mohammadfam, Ghasemi, Kalatpour & Moghimbeigi, 2016)

Most of safety issues are created by unsafe or careless employees. Worker's personal attitude is the common causes for accident or injuries. Most of accidents occur in the place of work due to workers negligence, failure of workers to obey work procedure and poor workers attitude about the safety (Ismail & Hashim, 2012). Further Sadullah and Kanten (2009) mentioned that many researches has been identified that employees unsafe behaviours at workplace are the primary determinant of the occupational accidents. Further occupational accidents are the result of random combination of most of issues found in the working environment. Generally reasons for industrial accidents are classified as unsafe behaviours of workers and unsafe conditions of the organization. Arunagirinathan (2013) revealed that considerable amount of workplace accidents are initiated through unsafe acts and unsafe conditions created by employees in the workplace. As leaders/employers, should to know that reducing accidents injuries can only be achieved by identifying, evaluating and implementing of controls of such unsafe behaviours or the Act-Risk Behaviours.

Fuller (2005 as cited Manjula & De Silva 2017) mentioned there is no general agreement on meaning of an unsafe behavior. Though, it has been identified in related focus on unaccepted practices which have the possible for producing potential accidents and injuries. Further, an unsafe act is described as a behaviour that is executed without bearing in mind to safety rules, regulation, standards and specified criteria in system, which can affect the system of safety level. ThulasiRajan

& Kumar (2016) identified that in industrial sector approximately most of the accidents are happened due to the unsafe human errors. Arunagirinathan (2013) declared the sources of human behaviors are connected with attitude, personality, motivation and memory together with physical and mental characteristics which comprise a person and his environment. Those are affecting to causes of accidents in the workplace.

Jothsna & Jegan (2017) mentioned that approximately 90% of workplace accidents happen due to unsafe behaviours. Myers (2003 as cited Byrd 2007) stated difficulty to control around 80% to 95% of accidents is triggered by unsafe behaviours. Lardner & Fleming (2001) highlighted that the human behaviour is an acceptable contributory factor in approximately 80% of accidents. Unsafe behaviour (human error) and unsafe condition, or contribution of both are the main causes of unplanned occurrences which results in injuries, fatalities, loss of production or damage to property and assets (Heinrich,2006, Al-Hemoud& Al-Asfoor, 2006, & Raouf, 2011as cited Manjula & De Silva 2017).

Safety Portal (as cited Manjula & De Silva 2017) mentioned unsafe behaviour is an element immediately affect to an accident/incident t which is considerable in initiating the event, while unsafe condition is unsatisfactory physical condition existing in the workplace environment immediately prior to an accident ever which is significant in initiating the event. Mullen (as cited Manjula & De Silva 2017) described that most recent researchers are debating that a majority of workplace accidents are occurred due to unsafe acts of the workers rather than unsafe working condition.

2.5 Contributory Factors for unsafe behaviours

Different contributory factors for unsafe behaviours have been introduced through different studies. Some of researchers identified safety culture, production pressure, role of the organization, social factors, organizational factors, economic factors, psychological factors as some contributory factors while others are highlighted lack of safety awareness, lack of resources allocation, worker attitude, workplace pressure

and stress, money spend for safety improvements are significant factors for increasing unsafe behaviours in many industries

Jitwasinkul, Hadikusumo & Memon (2016) pointed out a number of studies have been carried out for identifying organizational factors which are affecting work behavior, such as safety culture of the organization, performance evaluation, training facilities, management commitment for safety, communication system, availability of resources etc.

Manjula & De Silva (2017) illustrated different factors that have influence on unsafe behavior of construction workers as mentioned table 2.2. under three different category such as individual factors, work environment and organizational.

Table 2: 2 Factors in Influencing on Unsafe Behavior of Construction Workers

Category	Affecting factors
Person (Individual Dynamics)	• Age • Educational level • Experience • Gender • Alcohol/drug abuse • Psychological distress • Income • Attitudes towards OSH
Process (Work Environment)	• Hazardous Operation • Unsafe Conditions • Hazardous Equipment
Place (Organizational)	• Engagement by management for safety • Employee involvement • Proper safety procedures and rules

	• Efficient safety communication strategies

Source: Manjula & De Silva (2017)

Additionally ThulasiRajan & Kumar (2016) highlighted some contributory factors under same categorization. Below Table 2.3 pointed out those additional contributory factors presented by author rather than above illustrated. Additionally the author clearly explained those factors under each category.

Table 2: 3 Contributory factors for unsafe behaviors

Category	Affecting factors
Organizational Factors	• Safety culture of the organization • Levels of supervision – • Resources • Training • Working patterns
Job Factors	• Task • Workload • Environment • Displays and controls • Procedures
Individual Factors	• Attitude – Education and Training. – High impact interventions. – Enforcement. – Consultation and involvement in decision making. • Capability • Motivation

Source: ThulasiRajan & Kumar (2016)

Further Khosravi., at el (2014) added more key factors under different categories that may contribute to cause accidents and unsafe behaviour on construction sites as

mentioned on below table 2.4. The mentioned author demonstrated that factory under eight different categories such as society, work group, site condition, contractor, supervision and project management.

Table 2: 4 Factors influencing unsafe behaviors and accidents on construction sites

Category	Affecting factors
Society	National culture, race or ethnicity, education and training, economy, social support, social challengers, business climate
Organization	Policy and procedure, climate and culture, hierarchy and responsibilities, information management, project and job design, contract and contractors, resource management
Work group	Group norm and attitude, interaction, team work
Site condition	Hazardous operation, unsafe condition, weather, welfare services, construction stage, equipment
Individual factors	Attitude and perception, age and experience, drug abuse, unintended acts, intended acts, competency and ability, psychological features, competition
Contractor	Size, interaction, incentives, experiences, competency, subcontractor climate, subcontractor rate
Supervision	Effective enforcement, supervision style, safety engagement, communicate, competency, performance pressure
Project management	Safety leadership, commitment and support, management style, communicate, competency, review and feedback

Source: Khosravi., at el (2014)

2.5.1 Common indicators for unsafe behaviours

Analysing of all contributory factors which are introduced by different authors and identified through literature survey here can be summarized those factors which can be taken as common elements to study further as shown in below table, 2.5. The summarization can be illustrated under four main category such as social factors, individual factors, organizational factors and job related factors. Supporting of previous publication main contributory factors and their sub elements have been described under the table 2.5

Table 2: 5 Factors influencing unsafe behaviors and accidents on construction sites

Category	Affecting factors
Society	- National culture - Race or ethnicity - Economy - Social support - Social challengers
Organizational factors	- Safety culture - Policies and procedures - Commitment and support from management - Level of supervision - Consultation and worker involvement for safety - Effective communication system - Availability of adequate resources - Working pattern and planning - Training and educational facilities - Work place condition - Organization structure
Job related factors	- Working pressure - Subordinates behaviours

	- Working pattern - Availability of procedures - Working environment
Individual factors	- Attitude and perception - Age and experience - Drug abuse - Competency and ability - Psychological features - Competition - Training and knowledge - Competency for the work

2.6 Behavioural Based Safety (BBS) as a Positive Reinforcement to Reduce Injuries

2.6.1 Overview of Behaviour Based Safety

Behaviour Based Safety (BBS) is a term that is brought in to explain the avoidance of accidents, injuries and losses in the place of work. BBS connects the practical application of safety procedures based on real world behaviours of employees in work situation. Each person need to be considered their responsibilities for their own safety but also specially for the safety of others. Unsafe acts can be triggered as accidents and injuries in any acting place.

As per the Kaczmarek, Szwedzka & Szczuka (2015) determining regular work place safety issues allows evaluating the problem areas and create Behavioural based safety guidelines. Conduct behavioural change isn't achieved by changing the individual, yet by changing their view of mischance and by changing nature in which they work. It includes observing conducts and recognizing "in danger" or risky exercises, trailed by guiding or changing conduct to accomplish safe activity. Essential systems in BBS incorporate associate perception and criticism, preparing and training sessions, conduct based motivators, prompts, and objective setting.

As Krause at el. (2001) identified BBS as initiated in the early 1980s and that has fascinated through various copies that the BBS identification no longer means very much. It is time to take stock of the current scene and to draw lessons for the future of behavior-based safety. As defined by Earnest (cited Boeneker, Groves & Haight, 2007) BBS is an systematic method to improve safety in the working environment by establishing efforts in the people behaviors as mentioned in below pyramid under figure 2.5.

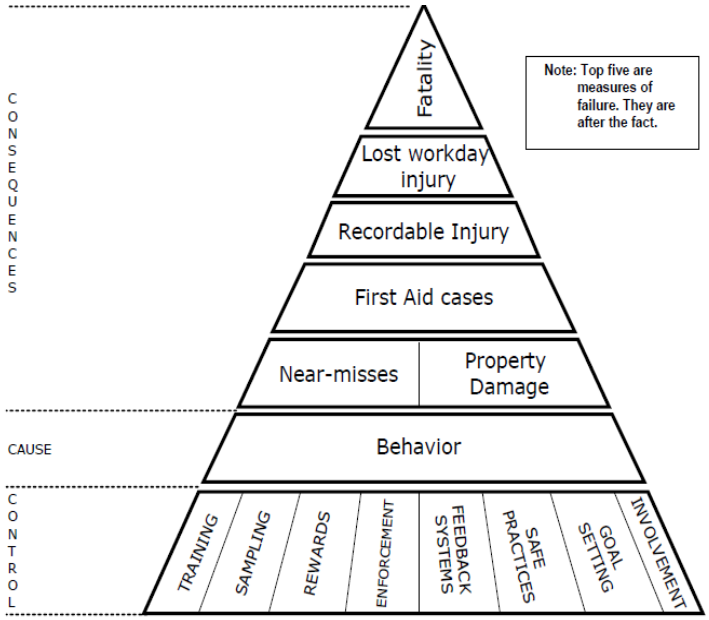

Figure 2: 5 safety pyramids

Source: Earnest (1985)

Chen & Tian (2012) illustrated BBS was one effective method of accident prevention broadly practiced by Europe and American countries since 1980s. It can be identified as safety performance guide such as accident rate and injury rate, change from dragging indicator to prime indicator. Further BBS can be facilitated one structural and quantitative approach for safety management and safety production long term mechanism. Behavior could be evaluated and enhanced by applying methods such as observations, analysis and feedbacks. In industrial sector various types of approaches have been followed to reduce the accidents rates and get better employee safety.

Ocon and McFarlane (2007) reviewed that BBS refers to safety programs that can be used positive reinforcement to change employee behaviors in order to prevent work related injuries and illnesses. By put into practice of BBS, any organization can directly engage employees' accident prevention and promoting them for more responsibilities for workplace safety.

As ThulasiRajan & Kumar (2016) mentioned BBS is the one of most effective method to follow to reduce industrial accidents in the workplace. Supporting of above statements Chen & Tian (2012) mentioned that most BBS advocators are considering that unsafe behaviors are main root cause for causing accidents and those accidents can be reduced by correct behaviors. Couching and encouraging employees for safe behaviors better than punishing employees for their unsafe behaviors.

Arunagirinathan (2013) argued BBS is the application of model of behavior change to actual issues. BBS is mainly focusing on what people do, reason for doing so and then applies a study supported for act of intervening approach to develop what people do. Further the author mentioned BBS is a method of reduction unsafe behaviors that can be leaded to injuries occurring in the workplace. BBS management focuses on the recognition and modification of critical safety behaviors and highlights how these are linked to industrial accidents or incidents.

But Ismail & Hashim (2012) revealed that behavior based process was developed in 1998 and was introduced as a part of a broader accident prevention program one that was initially paying attention on conventional safety. As Cooper (cited in Choudhry, 2014) identified BBS is a systematic approach of psychological research on human behaviour to the issues of safety. Additionally Fishwick at el. (2004) stated behavioural safety as a process of getting ahead of accidents by; being proactive, visualizing the possible most unpleasant consequences of a particular activity of behaviour, working out what might be done to mitigate those consequences and putting that into effect in the behaviour, so as to avoid those consequences.

As Lim & Lee (2011) identified BBS is the use of behavioral psychology to encourage safety, and typically involves creating systematic ongoing process that

defines critical behaviors reducing the risk of work related injuries. Jothsna & Jegan (2017) has been spoken about the BBS. As per them, the belief of the workmen should be changed. BBS is one of the best technique to use improve safety. It is effective to improve behavior of workmen rather than changing physical condition.

Fishwick at el. (2004) further brought up as Behavioural safety can also be come across as a range of techniques whose aims are to reduce likelihood and severity of accidents and injuries by increasing the occurrence of safe behaviour and reducing the occurrences of unsafe behaviours. These techniques of behavioural safety are based on validated the principles of behavioural psychology. Health and Safety Authority (2015) defined BBS is as a bottom up approach (frontline employees) with top down support from safety leaders. BBS systems implemented as people oriented and often integrate with individual or group observations of employees who are performed regular work activities, setting objectives and giving timely feedbacks on safety related behaviors, coaching and mentoring. The initiatives have a proactive focus, encouraging people and their work groups to consider the possible for incident involvement, (accidents) and to assess their own behavior as safe or unsafe always, no matter what.

Lardner & Fleming (2001) declared that behavioral safety techniques improve by recognizing and encouraging critical safety behaviors. Serious safety behaviours are promoted by changing the consequences of these behaviours to reduce or eliminate unsafe behaviours and to increase the occurrence of safe behaviors. Safety and risk control improves as the frequency of "at-risk" behavior reduces and the frequency of safe behaviors increases. There are few terms to utilize to addressed BBS; behaviorally-based safety, behaviour modification, behavioral safety management systems, safety inspection systems.

Chen & Tian (2012) mentioned in the figure 2.6 that basic principles of BBS for accident prevention. According to the Chen & Tian (2012) BBS theory basement is operational learning theory. Such theory advocates setup adoptable or ideal safety behavior by operating or refining learning process. The theory is designed on the inspecting human behavior without presuming human mental characteristics and

listing influencing factors on safety behaviors through inspections, rectification and evaluation then taken measures to give confidence for safe behaviors to accident preventions.

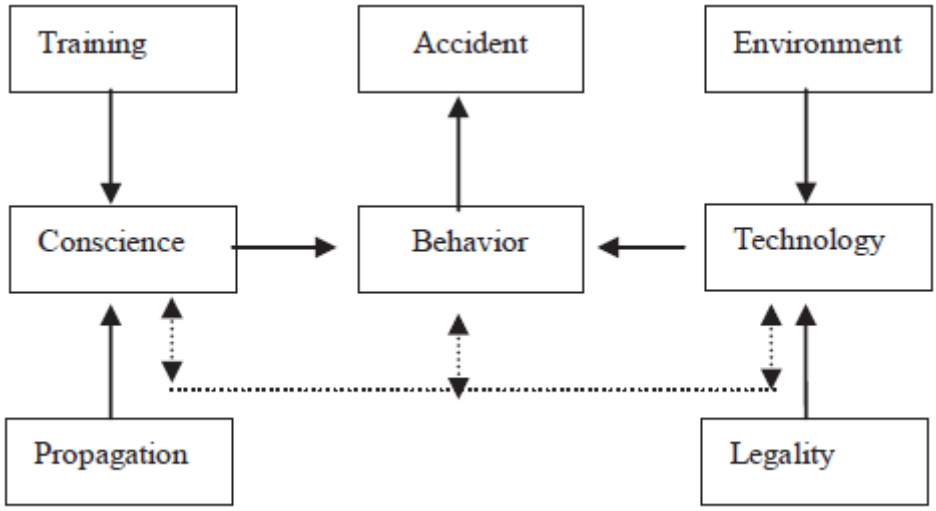

Figure 2: 6 BBS Principle to accident prevention

Source: Chen & Tian (2012)

2.6.2 Elements of Behaviour Based Safety

Azaroff and Austin (2000) found fundamental elements of BBS during their research as mentioned recognize (or target) behaviors that can be impacted safety, define these behaviors absolutely enough to measure them reliably, build up and apply a system to monitoring those behaviors to establish current statues and to set up practical goals, deliver feedbacks and reinforce progress.

Further Kaczmarek at el. (2015) revealed elements of BBS during his research as recognizing and practicing the vital safety related practice to each workstation, tasks performed or working background, implementation of evaluating technique to the identified practices, delivering their feedbacks to the employees who are evaluated, examination of the working pattern to suitable for effective practices and enhancing those practices or catch up difficulties preventing workers from using preset up practice.

As per the Lardner & Fleming (2001) many of research have been done to identify relative importance of component parts of a behavioral safety programme as mentioned on below figure 2.7, in order to set up how they can be optimally combined.

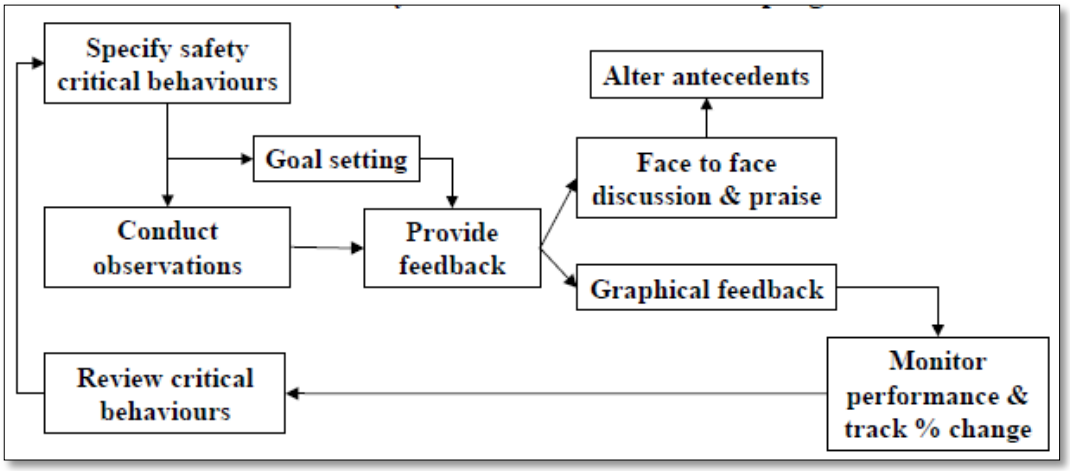

Figure 2: 7 Behavior based safety Observation and programme

Source: Lardner & Fleming (2001)

The authors themselves further mentioned the fundamental factors of behaviour modification under a six main step intervention process; first – initiating the preferred outcome or the results of the task or the individuals under inspection, second – mentioning significant behaviors that can be influenced their performance of the area that planned to improved, third – make sure that the individuals can role out their desired behaviors, fourth – as conducing ABC analysis technique on the current and desired behavior, fifth - modifying the results immediately following the desired behavior and then assessing the impact of modification the results on the behavior and the desired outcome.

Paul & Stenson (2016) stated components of Behavioral Based Safety. Spigener and Fisher (as cited in Byrd, 2007) identified and illustrated the components of Behavioral Based Safety as identifying critical behaviors, gathering data, providing ongoing feedback and removing barriers.

Stention (2016) pointed BBS is more successful when treated as a constant loop, continuously applying to employees, safety and business needs. According to the author BBS is most effective when treated as constant circle, continually get used to workplace employees safety and organizational requirements.

Furthermore Byrd (2007) mentioned the steps of implementing BBS program to any industry shown as planning the change strategy to ensure that the BBS program will add value to the company, identifying the problem and determining the extent of the problem, measuring the extent of the problem implementing the change strategy, evaluating the effect of change and correcting any deviations from the required changes

Xiongjun & Kaiquan (2012) illustrated below figure 2.8 to show the implementation procedure of behavior based management.

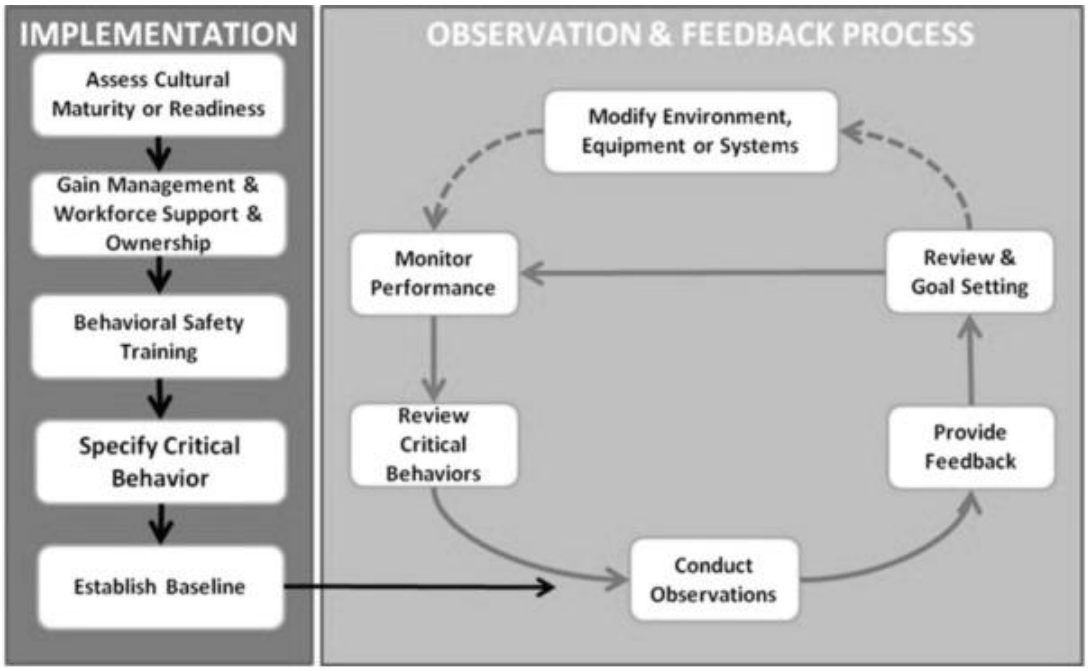

Figure 2: 8 Implement procedure of behavior based safety management.

Source: Xiongjun & Kaiquan (2012)

2.6.3 Applications of Behaviour Based Safety

Early applications of BBS incorporated to construction and manufacturing industries. Today BBS is applied to wide variety of industries and services (Lee & Lim 2011). ThulasiRajan & Kumar (2016) described some of applications of BBS for different industries as described through his survey under different authors as mentioned below.

BBS application for oil industry (Boeneker & Groves, 2007). The information described that figure and type of safe and at risk behavior recognized during the implementation. Another case study Ismail & Hashim (2012) conducted using three oil and gas companies in Malaysia who are practicing BBS to evaluate steps of implementing BBS and its advantages to reduce accidents and improve employee performance through behavior safety. Another successful study did for a oil and gas industry in India and get maximum output by Chakrabarty (2018). Fang, Huang & Hinze, (2004) used BBS approaches to another six construction site in China in order to improve their safety management system. Results revealed that BBS is a successful tool to evaluate site safety management system. Most of applications of BBS were done for construction industry.

Ismali (2011) used BBS approaches for oil and gas industry. When implementing the system he used basic four steps as identification, do observation, intervention, review and monitoring the system. There are five principles which will assist to the system. They are-to increase level of risk knowledge, feedback communication and bottom-up program approach, reduce paperwork and keep the process as much as easy.

Chen & Tian (2012) did a study to evaluate safety behavior & change trend in construction industry. According the findings showed that BBS made massive impact on accident prevention and the trial employee safety index was improved up to 10% than the baseline while the research. “DOIT” (D- Define the target behavior, O-Observe the target behavior, I- Intervene to Improve Behavior, T- Test impact of intervention) method was used to implement the BBS process in the industry.

Another study of BBS has been done for construction industry by HengLi et al. (2015). According to the survey results mentioned the accident prevention rates were increased and recording the behavior of employees when they are giving warning signals and observation of unsafe behaviors by adopting the concept. Chen & Ren (2015) did a BBS survey and applied the approach to a construction industry in china and got effective results of accident reduction and enhance employee behavior more than 10%.

BBS study was carried out for engineering students for their self intention and behavior in practicing safety at workshops and labs by using theory of planned behavior. The output results as mentioned attitudes towards the safety practices and perceived behavioral control have a significant effect on behavioral intent to safety practices Koo et al. (2013).

Xiongium & Kaiquan (2012) carried out a study on the countermeasure for BBS of small and medium scale enterprise. The procedure for BBS is consisting with Identify critical actions, collect action data, provide dual communication and eliminate the hindrance for safety behavior.

Another study was conducted by Mehra,, Kaila, & Saxena (2017) to a chemical manufacturing industry to maximum benefits of BBS in order to enhance safety activities among their factory employees. After implemented the system they has mentioned the feedback of the successful objective.

2.6.4 Advantages and limitations of Behavioural Safety Programmes

Lardner & Fleming (2001) stated that successful of changing behavior in improving workplace safety. According to the author focused on initiating, able to reduce accidents/injuries, to able to increase safe behavior and components in a behavior safety program are vital in changing unsafe behavior and minimize accidents and injuries.

Further ThulasiRajan & Kumar (2016) identified BBS can help to identify employees behavior which are dangerous and causes injury or accidents, minimize

the risk of accidents and injuries, help to collect information/data of frequency rate of those behaviors and feedback and reinforcement to create positive types of behavior in industry. Ismail & Hashim (2012) illustrated advantages of BBS approaches such as improve safety performance, reducing the number of accidents, guide employees to practice safe behaviors, reduce loss time injuries, improve safety culture, change worker's behavior, unsafe behavior can be identified and eliminated, improve worker's attitude, improve safe work environment, practice you see and you act and improving worker's health quality.

Further, as advantages of BBS approaches can be use to reductions in accidental releases of hazardous materials, reductions in breach of regulatory requirements, reductions in property damage incidents, improved security awareness and increases in critical tests and inspections conducted on schedule (Arunagirinathan, 2013).

México (2007) also identified Major limitations of Behavior Based Safety as the need for constant examine and support of safe work behavior, the need to adopt different types of implementation systems for different types of workers, need to develop a effective time frame for continuous support and monitoring, it is difficult to use if workers do not work with the same team on a regular basis, difficult to change embedded feelings and behaviors, limited success if there is high turnover.

2.7 Chapter summary

The main task of this chapter was to conduct thorough literature study to identify types of accidents relating to the printing industry, to study the background of unsafe behaviours and contributory factors for unsafe behaviours and to get better understand of BBS. According to the findings it could be emphasises some of types of accidents relating to printing industry such as chemical related, machinery related and other common types of accidents. Further it could be summarized contributory factors among various publications in to main four categories with supportive elements. Finally the concept of BBS and it's background including advantages and disadvantages could be recognized during this chapter which could be used for next chapters.

CHAPTER 03

RESEARCH METHODOLOGY

3.1 Introduction

The aim of this chapter is to demonstrate the methods that is undertaken to carry out this research of "*Behavior Based Approach for Enhancing Safety in Printing Industry".* It is illuminating by describing the research design, the research approach and the research technique which is used to evaluate gathered data to come up to the conclusion.

3.3 Research Approach

Research approach may be classified as the arrangement for moving from the research problem to its end conclusion (Tan, 2002). Easter by- Smith et al. (2002) mentioned the research approaches help to organize the research actions together with the data collection, in ways that are more likely to achieve the research final objective. There are number of research approaches such as experiments, survey, case study research, ethnography, action research and grounded theory (Konara, 2010).

Research approaches can be divided into main three categories as quantitative, qualitative and mixed method. The researcher looks forward to the nature of data needed to respond the research question (Williams, 2007).

Qualitative based research can be defined as a holistic approach that involves discovery. According to the Corbin & Strauss (1990) qualitative methods can be used to cover and be aware of any observable facts which are recognized. Further Creswell (as cited in Williams, 2007) this method described as a development model that takes place a accepted setting that facilitates the researcher to buildup a level of details form in top contribution in the actual experience. Further, Hancock, Windridge, and Ockleford (2007) pointed out qualitative research is concerned with initiating justifications of social phenomena. It means to say, that it aims to assist us to realize the actual scenario in which we be alive and why things are the way they are.

By using qualitative approaches, the researcher studies the entire population as individual basis or group basis and will recognize belief, understanding, opinions and views of people and analyze them to find a solution (Fellows & Lui, 2003). Case study, ethnography study, phenomenological study, grounded theory study, and content analysis comes under the Qualitative analysis approach. As per the Hancock, Windridge, and Ockleford (2007) qualitative based research is reflecting the methodological approach which researchers decide to take on. Many methodological approaches are illustrated as types of analysis, as ethnography, grounded theory, interpretative phenomenological analysis, discourse analysis, conversation analysis, content analysis, narrative analysis and others.

In this discussion of Behavior Based Safety approaches to reduce accidents in printing industry, the researcher selected qualitative based case study design due to the nature of the research problem and the prepared questions being asked from different interviewers in printing industry.

Qualitative based case study defined as an approach to research that facilitates examination of a phenomenon within its context using a range of data sources. It means to make sure that the matter is not investigate through one lens, but rather a different lenses which permit for several aspects of the phenomenon to be revealed and understood (Baxter & Jack, 2008).

Case study has been introduced by Yin (2014) as "*an empirical investigation that explores a contemporary phenomenon (the 'case') in depth and within its real-world context*". Merriam (1998) described qualitative case study as an *"intensive holistic description and analysis of a single instance, phenomenon or a social unit, but reviewing the statement further she has been seen case study as a thing, single entity, an unit around which there are boundaries".* Case studies are appropriate for depth a program, an event, an activity or one or more individuals.

In order to achieve the research objective, the researcher has to validate concept of BBS, advantages and limitations of BBS and existing approaches of BBS to reduce

accidents through literature studies. Yin (2011) testified why and how questions are basically under the case studies.

To accomplish the intention of Reduce Accidents Using of BBS approaches in printing industry, basically depth analysis in the industry relating to the accidents will provide a conclusion to the research. Hence Case study can be identified as the most suitable research strategy to this study.

Recognizing the qualities and limitations of the particularistic case study, this study is discussed objective and addressing the characteristics described for qualitative research. This study is undertaken to illustrate types of accidents and contributory factors of unsafe behaviours which are linked to accidents with developing the acquisition, retention, transfer and application of knowledge by utilization face to face demonstration and document review. This is a descriptive qualitative study which involves two particularistic cases. Two cases are involved to study their accidents behaviour and human errors for cause accidents and how can be effective address for those contributors to reduce mentioned accidents. Each case is scrutinized independently and then a cross – case analysis is made between cases.

3.3 Research Process

Figure 3:1 illustrated the steps of this study which is labelled as background study, identification of research problem, literature review, research design, data collection and data analysis which are details description presented in next section.

3.3.1 Background Study

Back ground study has been carried out for familiarizing with accidents relating to printing industry the subject areas of Behaviour Based Safety (BBS) factors affecting to BBS as well as application of BBS successfully use to reduce industrial accidents. The researcher referred books, research articles, web sites journal articles to grab knowledge regarding the BBS. Consequently research problem, aim and objectives, limitations of the study have been designed during the background study.

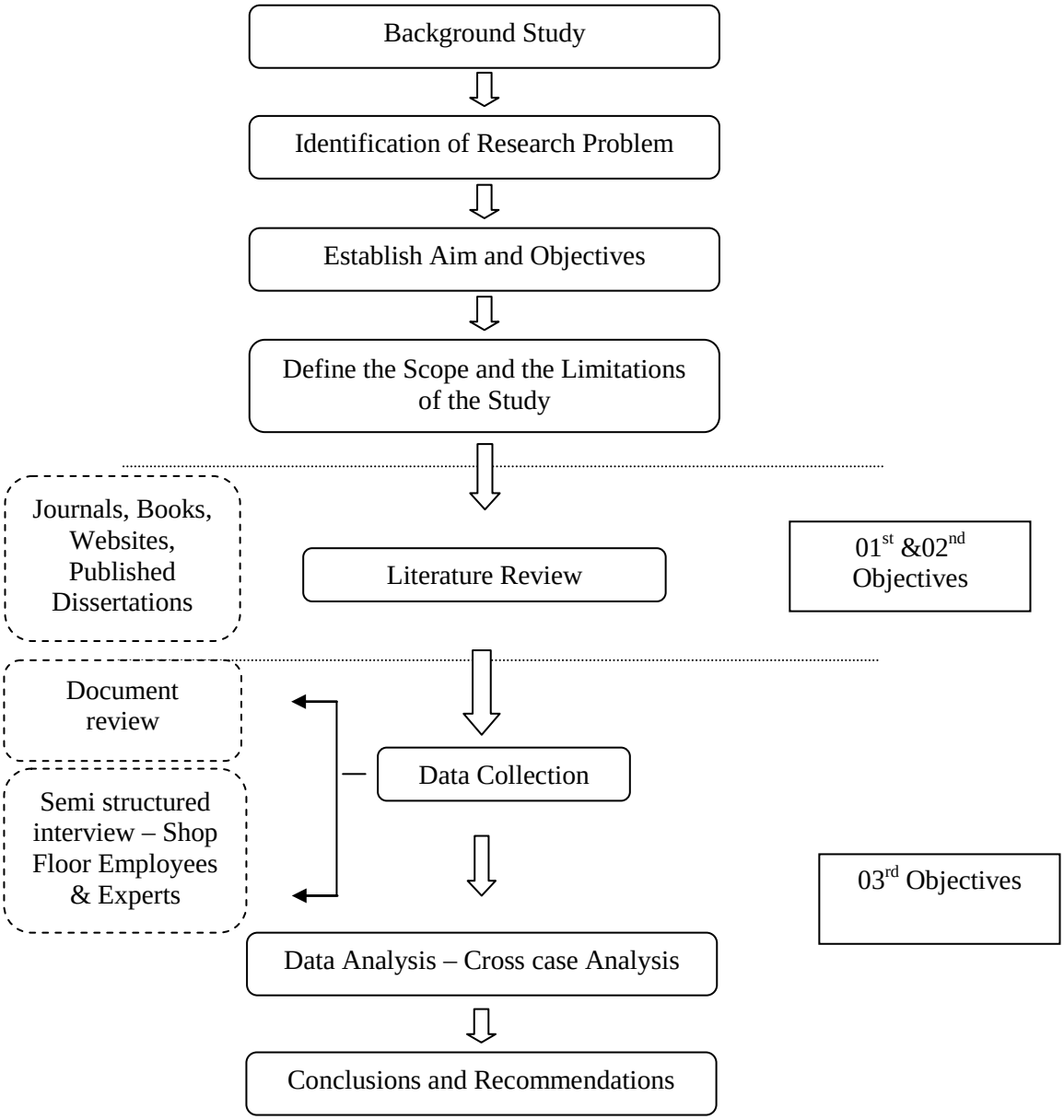

Figure 3: 1 Research Process

3.3.2 Identification of the Research problem

Even if various researches have been carried out for getting solution of reducing industrial accidents still the environmental of causing accident is same and currently there is a rapid increase in industrial sector specially printing industry in Sri Lanka. As per the analysis of root causes of each accidents unsafe behaviors of employees getting higher than other root causes. Hence the research mainly focused to improve

Behavioral Safety of employees who are working in printing industry in order to reduce accident.

3.3.3 Literature Survey

Addressing a clearly recognized aim and objectives through back ground study, a literature review is gradually developed while holding the focus on research aim and objectives.

Comprehensive literature survey has been carried out by referring books, journal articles, web sites and other publication to get the idea of types of accidents in printing industry, factors affecting unsafe behavior of employees which is contributing to cause accidents, concept of BBS and different successful application of BBS used for reduction of accidents. Throughout the comprehensive study of literature, it could be successfully achieved 1st to 4th research objectives.

3.3.4 Data Collection

Various types of data collection and data analysis methods are compromised in research techniques. It is the process of information gathering, measuring and evaluation on a targeted variable in an established systematic fashion which enables to answer a defined question and an evaluated outcome. Significance is selecting appropriate technique to collect data and analysis gathered data for the defined problem.

- **Case Study**

To achieve the research outcome successfully, the researcher selected case study method among different types of methods under qualitative study due to the behavior of the research.

In the meantime, there is no specified unique number of cases for a study. However if the number of case are high, the validity of the research will develop. Yin (as cited in Yin, 2011) identified there are two main categories of case studies named single based case studies and multi cased studies. Yin (2003 as cited in Gustafsson 2017) argued that apart from recognize the case and the nature of case study that can be

applied; the researcher has to think if it's wisely to make a single case study, or if it's better to do a multiple case study, for the understanding of the phenomenon. When a researcher is studying more than one case he should go with multiple case studies. The researcher is capable to investigate the data both within each situation and across situation or either augur similar results in the studies he may choose the multiple cases (Jack, 2008; Stake, 1995 & Yin 2003 as sited in Gustafsson 2017).

Accordingly for this study of Reducing Accidents using BBS approaches in printing industry is not effective analyzing with a single case. Hence multiple cases have to consider avoiding barriers of the study. As a result of that, two cases are selected in the printing industry. Hence researcher selected descriptive qualitative study which involves two cases to examine accidents in printing industry and existing safety culture relating to BBS and the link to their accidents. Each case was examined separately and then a cross-case analysis was made between these two cases.

- **Case Selection**

As mentioned above, there are two cases are selected by researcher due to maintain accurateness of the research. The selection of printing industry is derived with the criterion of no of employees, age of the factory and production background. According to that selection criterions, selected both printing industries are located in Biyagama Export Processing zone which are more than 15 years old factories. Both industries are categories as large scale printing factories which their annual production. Both are consisting with machinery related printing techniques and manual operations. Here with mention under table 3.1 the details of each case.

Table 3: 1 Cases information

	Description	**Case A**	**Case B**
01	Manufacturing items	Security related papers	Sails and Packaging
02	No of employees	Over 300	Over 250

03	Production pattern	24/7	Three shift pattern
04	Available departments	Pre Press, Printing, Finishing, Quality, Engineering, Security and HSE^2, Admin	Printing, Finishing, Quality, Engineering, HSE^2, Admin
05	Location	Export Industrial Zone - Biyagama	Export Industrial Zone - Biyagama
06	Gender	Most of people are male oriented and few amounts of females are working for finishing department and the administrative department	All are male workers in the printing and finishing sections and few of females are employing for administrative purposes.
07	Interview selection criteria – experience Age	Employees who more than 5 years experience	Employees who more than 5 years experience
		More than 30 years	More than 30 years
08	No of semi structured interviewers	14 Eight from printing section two from finishing section and four from engineering section.	10 Six from printing section two from finishing section and two from engineering section.

09	No of expert interviewers	2	2

3.3.5 Data Collection Techniques

Commonly used data collection techniques are interviews, questionnaires and surveys, observations, focus groups, ethnographies, oral history survey, case studies and documents and records review. Research is checking the suitability of BBS approaches to reduce accidents in printing industry and there enablers and barriers are essential.

Hence there are two types of methods are used to collect information.

I. Documentary review
II. Semi - Structured interview

Documentary Review: Last five years, accidents analysis reports are reviewed by researcher to identify types of accident and their actual root causes analyzed during last 05 years in each industry. Both organizations are maintained accident analysis report folder and it is consisting with all information which is relevant to the accident such as all personal details that are affected to the accident, property involved, behavior of the accident, base and root cause, learning points and process confirmation details. These documents are available in HSE department.

Semi Structured Interview: Blandford (2013) explained think widely are one way to gather oral information from different participants about the opinion and use of technology; interviews are another widely spread way of gathering oral data. Interviews may be more or less structured.

Selecting Semi-Structured interview method was helped to gather accident details and human view and judgments relating to importance of BBS approaches to reduce accidents in printing industry. Semi – structured interview guideline (questionnaire)

is basically developed to get accidents details controls they have implemented to prevent accidents and employee judgment for behavioral safety of the organization.

– Employee survey

There are fourteen respondents who were in shop floor were planned to select case A; and there are 10 responders selected from case B; those who are employed in printing (P), finishing (F) and engineering (E) departments' team members which can be leading subordinate employees. Selected all responders are male oriented and below table (3:2) shown the details of responders. The interviewers are selected those who are more than 5 years experience in the same workplace. The below table 3.2 illustrated information of each responders

Table 3: 2 Details of interviewers – Semi Structured

Case	Identification	Dept.	Age	Gender	Experience (Years)
Case A	AP1	Print	43	Male	20
	AP2		44	Male	18
	AP3		36	Male	13
	AP4		41	Male	15
	AP5		39	Male	14
	AP6		35	Male	9
	AP7		37	Male	8
	AP8		48	Male	20
	AF1	Finishing	32	Male	7
	AF2		36	Male	11
	AE1	Engineering	44	Male	10

	AE2		36	Male	9
	AE3		35	Male	9
	AE4		36	Male	10
Case B	BP1	Print	31	Male	6
	BP2		42	Male	16
	BP3		38	Male	13
	BP4		30	Male	4
	BP5		31	Male	5
	BP6		33	Male	6
	BF1	Finishing	31	Male	5
	B F2		30	Male	5
	BE1	Engineering	38	Male	13
	BE2		35	Male	7

As each employee was interviewed the questionnaire was brought to the interviewer and some of the key questions were interviewed s the structured portion of the interview. The questions which followed were open ended with a conversation format. Each interviewee was taken from ½ hour to one hour. Before the interview, researcher presented all questionnaires would be asked. Notes were taken during interview and transcript of the interview was set up at the end.

- Expert Survey

In order to validate collected information from case studies another two interviews planned to conduct from each organization selected as experts (senior managers). Selected interviewers are Plant manager/ Factory Manager and HSManager/ HSE

Advisor/EHS Engineer Category with minimum 5 years experience in selected industry. The identification of each organizational experts are illustrated below table 3:3

Table 3: 3 Details of interviewers – Experts

Case	Identification	Position	Age	Gender	Experience (Years)
Case A	AS1	Factory manager	45	Male	7
	AS2	HSE Advisor	32	Female	6
Case B	BS1	Plant manager	55	Male	15
	BS2	EHS Engineer	31	Female	7

The primary objective to conduct this interview is to evaluate and get a validation of semi structured interview feedbacks gathered from shop floor employees relating to accidents factors and get their judgment to way of improving BBS factors to reduce accidents. Interview is developed as questionnaire. The questions which followed were open ended with a discussion format. Each interviewee was taken to one hour.

3.3.6 Data Analysis

Drafted and created notes from each interview and observations from each cases. In order to best address each question, the analysis was carried out for all the cases. The first stage of the research, the researcher has use content analysis method to get feedbacks into a streamline. After gathering of each interviewer's feedback, all stored informations are analyzed systematically. This method was used for semi structured interviews for both employees and experts.

Cross-case analysis technique is the tool used to evaluate data in order to get a final opinion of BBS factors to reduce accidents in printing industry. Systematically made data, analyzed and conclusion derived using cross case analysis method.

Finally the resulted from expert validation the suitable factors of BBS is presented in chapter 04 to use reduce accidents and take in to mind for improving safe behaviors in printing industry. The below figure 3.2 is the map use for getting final conclusion.

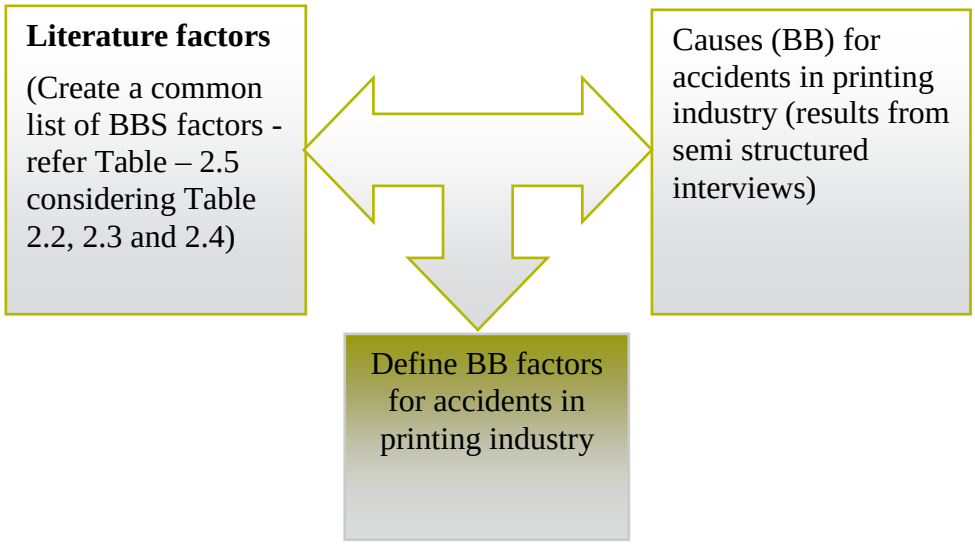

Figure 3: 2 BBS factors to control accidents in printing industry

3.4 Chapter summary

The chapter three was mainly created to talk about the research methodology together with research approach, data collection and data analysis techniques which were used to find out the research outcome. Interview method is considered as the best method to use to gather required information from selected cases. Types of accidents and contributory factors relating to unsafe behaviors were identified through literature study as a basic to analysis. Identified details analyzed using of content analysis technique and the cross case analysis technique.

CHAPTER 04

DATA ANALYSIS & FINDINGS

4.1 Introduction

The industrial revolution brings significant changes to the economy with the evolution of industrial sector. However it was affected to increase industrial accidents and increase the risk to employees.

Chapter 04 is presenting data with discussing accidents in printing industry, factors contributing to those accidents and the way of reducing accident through BBS concept. The research outcomes are presented as two particularistic case studies followed by a cross-case analysis.

4.2 Types of Accidents – case A

Case A maintains good accidents recording system according to their group H and S procedure. In interview conducted with Print crew, finishing crew and engineering crew from each shifts (AP1,AP2, AP3, AP4, AP5, AP6, AP7, AP8, AF1,AF2, AE1,AE2,AE3 and AE4) to gather of accidents information, it was noticed that they all have better experience of workplace accidents/incidents/ injuries during last 5 years.

According to the accidents details gathered from accidents reports the below figure (4.1) clearly illustrated as types of accidents and the no of accidents under each type during last 05 years. As per the details, Case A has been reported no of accidents during last five years. Accidents due to slips and fall and trips and fall are most common reported accidents in Case A.

Table 4: 1 types of accidents and quantity during last 05 years – case A

Type of Accident	No
Unsafe handling tools	7
Machinery related	4
Fall down from height	5
Manual Handling	3
Chemical related	6
Trips and fall	9
Slips and fall	7
other	1

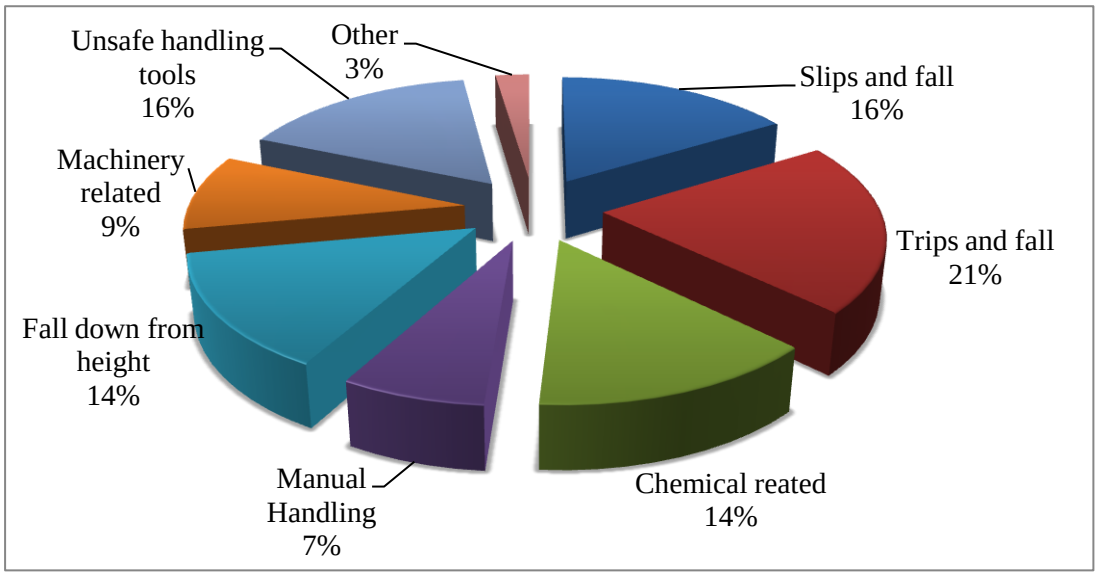

Figure 4: 1 types of accidents and no. of reporting during last 05 years – case A

Due to oil leaking through machines to the walk ways are the root causes to report **slips and fall** types of accidents. During the last five years 07 no of Slips and fall category accidents has been investigated and printers and one engineering employee had to face to accidents. During the discussion with the interviewers AP2, AP3, AP5 and AE2 have experience of slips and fall during last 05 years.

Highest and most common accident was **trips and fall (9)**. Most of trips and fall accidents (5 no.) have been reported due to contact with uneven floor in print area and printers are affected to the trips those five in print area. Another one was reported at the engineering workshop area due to stacking motors on the floor unsafely and one of engineering member tripped with a stacked motor. Next incident was reported at the finishing department due to unsafe handling of packing trolleys. Two incidents were reported under trips and fall category while handling powered pallet truck and manual pallet truck.

Ink and other supportive chemicals are the main raw material to the printing industry. **Chemical related accidents** are another reported accident category (06no.). Chemical related reported accidents such as splash and contact with the eye, burning hands, explosion due to unsafe mixing of hazardous substances. These all accidents have been reported due to unsafe handling hazardous substances.

Accidents (ergonomic issues) due to **unsafe manual handling** of materials (03no.) were another reported type of accident in case A. Most of supportive material handlers were exposed to manual handling incidents. During the last five years four numbers of manual handling accidents were reported and investigated by case A HSE team.

Fallen down from height is another type of accident has been reported in case A. Fall while working platform and fall from access stairways are reported areas from this category. Six numbers of accidents reported and investigated during last five years.

Machinery related accidents (04 no) were another category of accident reported and investigated in case A during last five years. Printing employees, finishing department and engineering staff exposed to machinery related accidents. Printing industry most of machinery is consisting with rotating objects such as ink rollers as industry mentioned wiping and shablon rollers. Most of machinery related accidents were reported due to contact with rotating (moving) objects (AP1, AP3, AP4 and AF2). AP1 has an experience with a machinery related accident. It has happened due

to unsafe using of machinery safety guards. He tried to reach rotating shablon roller while bypassing safety guard for ink cleaning of that rollers. Finally as the result his finger had been crushed with rotating roller. And it was reported as reportable injury. Another reported machinery related injury was (AF2) contacted with moving part of a cutting machine in the finishing department. As per the AF2, his right hand hit with moving part and need to get medical treatment. Another accident reported due to touch with rotating rollers in a conveyer in finishing department. AP4 got and experience working with ink mixing machine. During the discussion he mentioned that he has lost his left hand finger due to crush in between rotating ink mixing rollers.

Unsafe handling of tools: This is a common type of accident any industry. As per the interviewers' feedback most of tools related minor category accidents are not reported by themselves. However referring accidents data book and employees' judgements, 07 no of accidents were investigated by their HSE team. These all are minor finger cut injuries and graze injuries

Other – unsafe work environment arrangement: It was found that, a high potential injury reported during last year in case A due to unsafe workplace arrangement by engineering team.

4.3 Factors affecting to accidents – case A

As per the gathered information from accidents analysis reports, semi structured interview and the expert survey, here with mentioned factors contributed for those accidents. When conducting the semi structured interview with selected shop floor employees, their judgments are structured and concluded to get final opinions. Expert survey is conducted to validate these semi structured interviewers feedback and to get experts view relating to contributory factors for their reported accidents and their view for improve behavioural factors.

According to the above classification and further discussion had with both experts case A (AB1, AB2), it can be clear understand most of reported accident occurred

due to unsafe act/behaviours of case A employees as described below of contributory factors.

1. ***Individual factors - attitudes and lack of motivation for safety culture and poor perception***

Among reported accidents and injuries Case A, individual factors are the common causes for accidents and injuries. Among all investigated individual factors, as verified by both experts (AS1, AS2) poor attitudes, lack of motivation and poor perception for safety culture are most common evidences for practicing poor safe behaviors which can lead for industrial accidents and injuries in case A. Align with personal attitudes negligence of safe procedures and guidelines and using shortcuts are other common factors for accidents and injuries.

"*Most of our employees' feedback of safety is very poor. Their perception for building up better safe culture, making safe decisions, taking responsibilities to buildup safe working environment are only for HSE managers' task.*

The results from analysis taken from employees' interviews and the both experts AS1 and AS2 verified that a disproportionate number of accidents were slip trips and fall. Slips trips and fall accidents may often occurred due to walking through leaked oil and grease in printing machines, walking through adjacent walks ways etc.

As mentioned by experts *"employees are not attending to clean their machinery areas when we asked them to clean oil on the floor. They just pointed out engineering team. Employees are not attending to clean or remove those hazards from the originated point. They are not seeing the risk is to them"*.

Machinery related accidents and chemical related accidents were identified as the other common major accidents reported in printing industry. As per the accident investigation reports and expert (AS1) judgment main root cause for these accident categories is using short cuts and unwilling to use PPEs. Majority of machinery related accidents have been leading due to poor compliance to machinery safety standards such as operate the machine with open safety guards.

Relating to the individual attitudes, all interviewers' under semi structured interview view for reporting of accidents/ incidents and near misses are poor in case A.

According to feedback of case A interviewers who are in printing section (AP2, AP3, AP6 and AP8) consider that near misses reporting as an additional task assigned to employees. So they are refusing to report near misses and HSE related observations. As per the case A expert – AS2, factory employees are willing to find those observations and report, if they receiving monitory valve for those reporting, if not it will consider as useless task. However this may lead to cause of number of accidents in industrial sector.

2. Education and training

As per the most of interviewers (AP1, AP2, AP4, AP6, AF1, AF2 and AE1) knowledge of the best safety practices is very low. They believed that the requirements of refresher trainings under different safety matters always helping to develop better safe culture. Even though they have different documents, their judgments were lack of time and work pressures are providing minimal time to enhance their knowledge. Hence they are requesting more trainings and educational campaigns relating to the safety.

"We always run to a set up target. There are number of documents available in the machine but we could not have a time to go through". We believing that those all are very important to us. However with the time we are struggling go refer documents and follow good practices".

Case A both experts accepted that their shop floor employees' lack of safety knowledge always leading to cause unsafe behaviors and reason for accidents *"lack of education and training or inadequate trainings for employees always support for accidents"*

3. Policies and Procedures

Case A experts (AS1 and AS2) mentioned that they have created good quality safety policies, work related safety procedure documents and those all are up-to-date. Further, AS2 has highlighted that all work related documents such as SOPs and risk evaluation documents are displayed relevant working areas to review at any time.

However during the interview conducted with AP1, AP3 and AF1 mentioned that they could not have a chance to refer those documents even those documents have

been displayed in working areas, because of tight work schedule, language issues etc. *"there are so many work instructions, SOPs, risk analysis for each process in every machines. Our management has given positive attention for created all safety related instructions. At the moment we could not get a chance to review those documents and the guidelines with the tide schedule. We would prefer someone can explain in easy way may effective".* Hence they brought up as a solution to explain procedures and ask them to give them to chance to involve creating documents. Shop floor interviewers (semi structured) – AP1,AP2,AP5,AE2 and experts (AS1 and AS2) mentioned that they can see employees' unsafe behavior due to the gap in understanding of policies and procedures. This non-compliance to policies and procedures were leading to cause some workplace accidents such as manual handling related accidents, working without safety guards etc.

4. Management commitment and support

Case A both experts mentioned that their management commitment and contribution for safety is in a satisfactory level. Management plans' top priority always has been given for safety. Their supports always have been given to review procedures, implementing new safety strategies etc. Daily safety walks, dissuasion of safety matters in daily meetings, participating for weekly safety meeting by management always encourage and help to employees change their attitudes and to develop good safety culture to the organization.

During the time of semi structured interview, all interviewers also stated that they have good management contribution towards safety and managements' first priority is giving to safety when implementing procedures at all times. As per their judgment it could clearly understand that all factory employees are happy with the constant support they receive from the management to develop their safety behaviors. However they expect more support further to reduce accidents while improving their behaviors.

"*We have so many behavior development trainings per year. Number of safety related posters, toolbox talks, safe walks are conducted and highlighted, explained unsafe behaviors, good practices by management.*

5. Work related pressure

As mentioned by AP2 and AP3, work related pressure for achieving setup targets are directly affected to the workplace accidents. They have highlighted that it is directly affecting to lead shortcuts while performing to the production due to tight production schedule. *"We believe safety is the number one. However we all are always running with a shift target. End of the shift we need to achieve the target and if not we need to give explanations. So our team does not care safety even though they knew safety is a must for our life".* During the time, as understood their employees could not have a chance to follow about best safety practices due to unacceptable targets and work pressure. Reported 03 accidents due to fell down from the machines were led due to shortcut methods and the work stress.

AS2 expert also accepted that case A employees are working under pressure and it is one of the most likely contributory factor to cause their accidents.

6. Unsafe conditions of the organization

Unsafe condition of the workplace is directly linking to cause accidents while improving unsafe behaviors of employees. As pointed out by AP3, AE1 and AE2 they do not take an opportunity to change their behaviors to improve site safety culture as they believe it is additional task to them with the work pressure. Unsafe working condition always support to the above mentioned attitude. As an example highlighted by those interviewers during discussion, they don't attempt to point out/correct damage floor/uneven floor since it is not their task.

"Why we engage to highlight and correct the working floor. It is not our duty. We have to achieve daily target. We are working for that".

Even I have argued with this statement, it is understood that they are accepting unsafe working condition and working with the same environment. Most of the accidents have been occurred due to unsafe working environments.

7. Worker involvement for safety

Case A employees are always involving for safety related matters as mentioned by both experts and semi structured interviewers who AP7 and AP8. As they mentioned, their *safety is everyone's responsibility. Daily safety walks, safety related checks, weekly meetings, discussions, involvement for evaluation of task based risk assessments are some of task of our team have to involve at the workplace.*

Case A experts also mentioned that "*our team is actively participating to daily safe walks, provide accurate and effective suggestion for highlight".*

8. Communication

As believe by both parties communication is an important factor to change employees' behaviors to develop better safe culture while reducing accidents. Case A employees have a chance to discuss their safety related matters at all time since they have good relationship between top and bottom as highlighted by AP4 and AP7 during the semi structured interview, *"we have a good communication system, during the Safety meeting, daily meeting there are opportunities to see our performance relating to the group".*

As a good practice, management is presenting monthly safety related site KPIs to the shop floor. Good communication factor is always helping to change their attitudes behaviors to positive safe culture as mentioned and agreed by both interviewers – shop floor and experts.

"*Unplanned such as Pocket meeting are always helping to communicate safety related massages very easily and quickly. "Employees are always attending to discuss their safety related issues during those short discussions. Sometimes those are good solutions".* Further experts mentioned that; *"keeping of direct communication always support to shearing ideas and suggestions, immediate solutions which are supporting to achieve site safety goals".*

9. Review and feedback

As a good practice, case A maintains an acceptable accident review and feedback communication system. As highlighted by AF2 and AE2 not only the accidents feedback details, their management trying to communicate safety related feedbacks to their employees at any time such as KPIs, accidents investigation feedbacks, Daily highlights etc. "*weekly conduct safe meeting is more effective*. *During the weekly meeting employees can get site performance update in weekly basis".* As per the experts in case A employees are always looking for the performance.

Hence it should be accepted that the factor – review and feedback is helping to change employees' behaviors to reduce accidents and buildup safe culture.

10. Age and experience

Lack of experience is always link to cause accidents as accepted by case A semi structured interviewers. During the discussion had with AF2, he shared his experience as he had to face an accident due to lack of experience to work in the cutter machine. "*When I just joined to the finishing team, I had to study and train all processes under a senior operator. However I decided to operate the cutting machine even I did not have more experience and training on that process. Unfortunately my left hand was trapped in between clamps. Fortunately one of my senior operators immediately attended to the machine and stop. I believe it was not happen if I'm fully competent to the cutting process during that time".* As experts – AS1 and AS2, and accident reports feedbacks derived that most of accidents have been reported due lack of experience in case A specially machinery related and manual handling.

Hence as a good practice case A is conducting job trainings for less experience employees.

11. Availability of resources

Lack of availability of adequate resources is another key contributory factor which is doing negative changes of employee behaviours. According to the ApP3, AP5, AP6

and AE4 they have been provided adequate resources to use when they are performing task. However lack of some information relating safety and other safe practices such as lack of availability of standard materials, employees are going to make custom made tools and equipment which are not accepted. Further they argued that some tools related accidents happened due to this custom made unsafe tools and equipment. Hence they additionally requested to deliver the message of to provide adequate and suitable resources to worker to mitigate accidents. "*We have good quality tools and equipment with latest technology. But those are not easy to operate and also some of them are not relevant to the task. No proper SOPs for some tools and equipment. As a result our workers modify customized tools and equipment according to their requirements. May be those are not acceptable and not safe to use".*

Case A experts also accepted the above comment and they agreed that there is a positive relationship with lack of resources and unsafe behaviour which leading to cause accidents.

4.4 Types of Accidents – case B

Case B represented satisfactory data management history. When considering last five years accident figures, it was founded the below mentioned accidents and their behaviours. The below figure 4:3 clearly illustrates the number of different types of accidents reported during the last 05 years in case B.

Table 4: 2 Types of Accidents and quantity during last 05 years - Case B

Type of Accident	No
Unsafe handling tools	22
Machinery related	4
Manual Handling	4
Chemical related	12
Trips and fall	7
Slips and fall	4

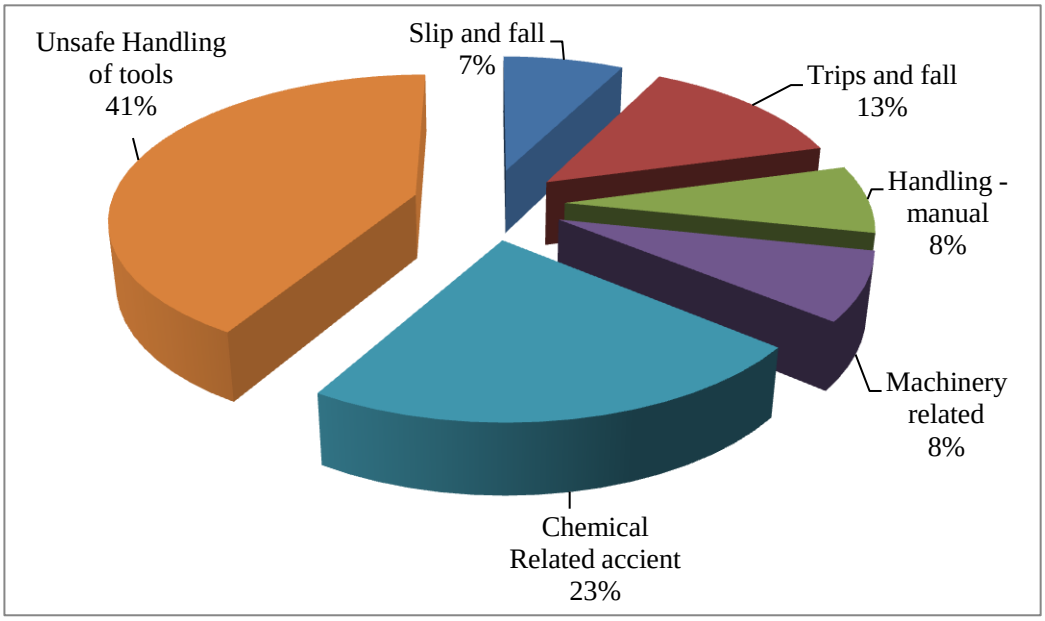

Figure 4: 2 types of accidents and no. Of reporting during last 05 years – case B

Four numbers of **slips and fall** related accidents have been investigated by Case B HSE team. Main root cause for all slips and fall accidents was leaked oil and waste water on the working area. Slips and fall occurred due to walk over the oil/waste water leaked area without cleaning or repairing the leakage area.

Another most common, reported and analysed type of accident was **trips and falls**. Three numbers of accidents were reported due to tripped with uneven floor and uneven steps. Uneven floor was at the print section. BP1 and BP2 both had experience of tripped with uneven floor. BP4 had experienced with trips and fall due to a tripped with a trailing cable laid across the walk way. It was reported as a first aid injury. Again BP5 and BP6 shared their own experience with us relating to the trips and fall. Both employees fell to the floor due to tripped with fixed objects as guards which were fixed to protect pipe lines cheerlessly fixed. Another serious accident was reported case B, assistant printer got on a pallet and did some work. While he got down tripped with a near parked pallet truck and fell to the floor. As a

result his right leg ankle born was cracked and reported as a reported injury with five day lost time.

Another take consider type of accident was **ergonomic issues** due to unsafe manual handing and bad posture. Four number of back injuries were reported during last five years. Even though they are complying with proper tools and equipment most of large scale sails are handling by manually. That was the root cause to report ergonomic issue. All other injuries were maximum two days lost time cases instead of one reportable case.

Chemicals related accidents such as splash/contact with eye is a common type of accident in Case B. During last 05 year 12 no of eye injuries were reported. Fortunately all were first aid injuries instead of one case.

Few number of **machinery related accidents** reported in case B. Only four number of accidents had to review during last 05 years. All four reported due to unsafe operating of available two machines in the production area. Results were trapped finger with rotating machine. While discussing with BP3 he mentioned that he has lost his middle finger nip due to crush in to a print machine.

Injuries due to **unsafe handing of tools** are another common type of accident in case B. As per the reviewed data cut injuries due to unsafe handling of sharp tools, scratch/ graze/scrape, abrasion injuries are most common and some are not reported and investigated due to lack of communicating to the relevant authorities. 22 number of tools relate accidents were investigated during last five years and all are first aid related injury which are got treatment and come back to the work less than one day.

4.5 Factors affecting to accidents – case B

According to the interviewed details with Case B employees and experts, reported all accidents occurred due to employees' unsafe behaviours. Below described contributory factors have been supported to those accidents.

1. Personal attitude and perception

A good safety culture can be made out by their employees' attitude and their perception. A strong safety culture is always associated with positive attitudes among organizational workers which can influence the adoption of safe behaviours and reduction of organizational accidents and injuries. Negative attitude call negligence supports to cause organizational accident injuries in case B as per both experts judgement. According to the expert – BS 1 and BS2 updates, "*most of employee related accidents such as slips/trips and fall, machinery related accidents, chemical related accidents occurred due to employees negative attitudes which are support for unsafe behaviours".*

Semi structured interviewers specially - BP1, BP2, BP4 and BP6 perception for the safety culture is negative and their mind built up as it is a pointless effort. *"Why we are engaging with unnecessary task which are not belongs to us. We have to focus only the production target. We could not do irrelevant task within our time period".* As per the expert – BS2 feedback, "*most of factory employees are always trying to reject safety practices and follow their own methods which can cause injuries".*

According to these feedbacks it can be concluded in Case B employees' personal attitude and their perception towards safety culture has a direct link with reported previous five years accidents.

2. Education and training

According to the case B – expert BS2 *"Strong health and safety related education and training programs are not only improve employee retention but also compliance with health and safety requirements. Safety related training is an important factor in developing excellence of safe culture".* Well-planned and properly managed safety related training programs always highlight to support safe work practices**.**

Observations through the accident records and semi structured interview feedbacks in case B as a conclusion it can be revealed that workers are in poor education and

trainings at work gained no evident safety knowledge or awareness with accumulation of experience on the workplace. Further as per the two experts industrial employees have lower level of educational attainment. *"Good education background is always helping to change attitudes and behaviours".* As they believe this is another contributory factor to report unsafe behaviours for safety. Lacks of training facilities are supporting to build poor safety educational environment more.

3. Policies and procedures

Effective safety policies and procedures are leading good safety culture in any organization. Good quality safety management system is consisting with good safety policy and other documents such as safe best practices, risk evaluations and controls and other work permit.

Lack of safety related policies and procedures towards the safe behaviours are leading to cause accidents. Case B semi structured interviews' and experts mentioned accepted that they don't have adequate safety policies, procedures and guidelines for best safety culture. They have not addressed all activities in case B process. Hence employees are following their own methods may causes failures and support for reported accidents. BS2 accepted that the requirement of improve their policies and procedure to build-up safety in the organization.

"Our site does not have good policies and procedures system. Still we need to create more procedures for some processes available in the system. Since worker's does not have a solution, they follow the process as per their own knowledge. We believe that immediate attend to make adequate and effective procedures are mandatory to see best practices of our employees".

4. Availability of resources

Availability of adequate and effective resources is always helping to protect people and also always support to improve employees behaviour. As per the semi structured interviewers judgement, they do not have adequate resources to use their print

process. During the discussion as an examples they have highlighted printing and finishing section employees need special tools and equipment such as cutting tools for roller sharpen. Due to lack of suitable resources they are using custom made tools and equipment which is not to use. Not only are that employees using custom made which is unsafe tools and equipment for their easy use. While presenting the above judgement to expert to get their feedback for the purpose of validation, they also accepted the neediness of required safe tools to the process.

Hence it also can be accepted as a contributory factor to cause unsafe behavioural accidents

5. Management commitment and support

Upmost importance of management support involvement and their commitment for safety. According to the all participant for the discussion, management commitment and support are in acceptable level in case B to reduce occupational accidents.

All experts and shop floor interviewers who are participating to the semi structured interview, experiences demonstrated that management commitment to safety creates motivation throughout the organization. BP1, BP4, BE2 and BF2 expressed that their management commitment for safety is poor and they believe commitment and support can show itself through providing financial, personnel and time resources, as well as management support and safety measures such as to set up training courses which can improve behavioural safety of employees. *"Unfortunately it can say, the support to create better safe environment from our management is not sufficient. They are only always focusing to the production. It is better to have proper system to get their support to discuss our safety matters also their contribution for safety".*

BS1 and BS2 accepted the argument and they revealed that management must show to the employees that the importance of safety and health is more than production, safety first must be truly implemented in the workplace. Further both experts accepted that this is one of the considerable factor to improve in order to reduce accidents and support to improve behaviour of factory employees.

"Yes. That is true the factor of management support and their commitment is vital always to our workers. Management contributions always make a sign to our worker to work safely".

6. Pressure for work

There is a positive correlation between work related pressure and the accident rate in an organization. Work related pressure makes employee stress which can support for accidents. As per the discussion had with shop floor interviewers, employees are working under a daily target scheme. Also supervisors and the management are always forcing for better output. During the interview, BP4 and BE2 mentioned "*sometime people are trying to use unethical ways to do their jobs without considering safety best practices. Further they are trying to use shortcuts to do their jobs to work for their daily target. As an example can be mentioned working with bypassing safety guards in roller machines. Most of machinery related accidents were occurred due to using shortcuts".*

Also they believe, work with pressure is always leading to cause accidents since employees' mind were set up only for the work not for the safe work. Hence there is a high consequence to cause unsafe acts. Therefore work with pressure is one of a closer factor to cause some accidents and do unsafe behaviors by factory employees.

7. Worker involvement for safety

Worker involvement for safety is one of the significant factor which can be supported to enhance/to build-up employee behaviour towards safe culture and reduce industrial accident as mentioned by case B experts and shop floor interviewers who participate to semi structured interview. Few employees are selected and nominated as safety team members by HSE team, in case B. As declared by expert- BS2, they are the members who rollout safety culture in the organization. These team members are participating monthly safety meeting and safety discussion. However, when referring the semi structured interviews' feedback, the involvement of employees for safety is minimal. As mentioned; they can build up better safe culture and reduce accidents and improve employees' attitudes toward safety if they

could involve for risk evaluation preparation procedure for safe practices share ideas. Both experts agreed that worker involvement and allocating responsibilities to their employees for building up safe culture may help to improve employee behaviours and reduce industrial accidents.

8. Unsafe conditions of the organization

Safe working environment is always support to build up employees' behaviours and reduce accidents. However, as semi structured interviewers pointed out case B is consisting with some of unsafe working areas which can support for accidents. "*Water leaking area, uneven/damage working floor, slippery floor due to wooden attached to the floor. Further machines with damaged safety guards, damaged electrical appliances are highlighted few examples. Due to poor organizing, these unsafe conditions are still remaining same. Hence employees also not considering safe behaviours since they have to work in an unsafe working environment".*

As per the BS2's judgement, unsafe condition areas of the case B had been support to occur some accidents such as slip, trips and fall, electrocutions etc.

9. Communication

As all believe, communication is another vital factor for better safe culture. When discussing of contributory factors for unsafe behaviours and reported accidents with experts and shop floor employees who are participate to the discussion, they all confirmed that, upward and downward communication is essential to develop good safe culture.

"The relationship should be always top to bottom and bottom to top. As BS1 presented, "*employees can share their ideas for development of safety culture through better communication system"*. Both expert accepted that their organization need to more improve their relationship between management and worker to see better safe culture.

10. Review and feedback

Employees presented that positive feedback and encouraging for safe behaviours for employees' unsafe behaviour is better than punishing to their unsafe behaviours. Further they have mentioned that review of accident details and share outcomes are more important to correct their failure. Case B does not have proper feedback system for accident investigation, periodic review of policies and procedures etc.

11. Age and experience

Age and work experience have been highlighted in investigations seeking correlation between workers and the accident rates. All shop floor interviewers accepted that young workers age in between 18 to 28, who have less work experience shows unsafe behaviour. Neglecting of safe practices and less caring of safety are some of root causes for several industrial accidents. *"Young employees always cause problems since they do not have more experience".* As per the expert – BS2 view more than 5% of workplace accidents have been reported among less age and less experience workers during last five years.

4.6 Cross - case analysis

Multiple cases are providing opportunities to illustrate similarities and explore differences in each scenario. A multiple case study allows one to look beyond the individual case, to the phenomenon, in this case types of accidents, behavioural factors which are contributing for industrial accidents.

In the cross case analysis researcher needs take in to mind that where areas in two cases pointed out as same judgments and different areas and where two cases are disagreement when presenting details of types of accidents in printing industry and contributory factors for unsafe behaviours.

When summoning up those findings first the researcher identified and told about types of accidents relating to the printing industry. Here the researcher highlighted

physical accident in printing industry. Researcher did not study health related injuries or illness from both cases.

4.6.1 Types of accidents

Based on the collected information relating to the accidents in printing industry, slips and fall and trips and fall are the highest amount type of accidents in both cases. When analysis those type of accidents similar root cases are presented in each accident reports. Chemical related accidents also another most common type of accidents highlighted in printing industry. Since their product are mainly containing with inks and other substances. Due to the unsafe handling of hazardous substances and other ink were led some accidents in both cases.

Also accidents due to unsafe handling tools and equipment are reported and illustrated in both cases. According to the interviewed details results of unsafe handling tools are also same in both cases.

Even though ergonomic related accidents and machinery related accidents were reported in both cases, their amount is different. These types of accidents are varying according to their practice and processes. Case A does not have much manual handling task, most of tasks are performed using with machines. Case B employees are doing considerable amount of manual handling task in their process. That was the reason to report higher amount of manual handling related accidents in case B and less amount in case A. Further when considering machinery related accidents also presented same scenario. Higher no of machines and technologies are using by case A and les amount of machines are utilising by case B for their printing processes. Even though these types of accidents are common to printing industry, these factors are linking with their practices and processes.

4.6.2 Contributory factors for unsafe behaviours

Early paragraphs described contributory factors for unsafe behaviours and to the reported accidents in each case separately. The findings from semi structured interview and get validation those findings through exert judgments of cross case

analysis generated with reviewing these all contributory factors for unsafe behaviours which are supporting for accidents in these two cases. Below table 4: 1 demonstrates summery of each unsafe behavioural contributory factor to cause accidents in each cases according to finalised by expert validation.

Table 4: 3 contributory factors for unsafe behaviors in each case

Contributory Factor	Case A	Case B
Lack of personal attitude and perception	Accepted	Accepted
Lack of education and training	Accepted	Accepted
Lack of policies and procedures	Accepted	Accepted
Lack of availability resources	Accepted	Accepted
Lack of management commitment and support	Accepted	Accepted
Pressure for work	Accepted	Accepted
Worker involvement for safety	Accepted	Accepted
Unsafe condition of the organization	Accepted	Accepted
Poor communication patter	Accepted	Accepted
Review and feedback	Accepted	Accepted
Age and experience	Accepted	Accepted

According to the table both cases are accepted one of individual factor personal attitude and their perception is one of contributory factor for employees' unsafe behaviours and causes accidents. Both cases experts are explained that personal attitudes and employees' perception for safety is directly linked to previous reported

accidents and lead their unsafe behaviours. Such as slips and fall, trips and fall, machinery related accidents, some of chemical related, unsafe handling of tools are some of examples to describe here.

Both cases employees and experts mentioned that lack of training and education are directly linked to root cause for employee unsafe behaviours and some reported accidents. When reviewing both cases contributory factors, such as ergonomic issues which are filed to follow safe manual handling practices etc.

Case A experts presented that even they are maintaining good policies and procedures, acceptable management commitment for safety, and availability of good resources, employees are following custom made methods to do their job which can lead some accidents such as machinery related accidents. Employees also accepted that they are not much referring procedures and available guideline documents. When considering case B experts and employees are accepted that they do not have good policies and procedure system, acceptable management commitment for safety even they are not good resources to use. So these may have led some accidents. Also both industries accepted that pressure for work is mainly link to cause unsafe behaviours and help to cause accidents. As illustrated by employees in both cases, worker involvement for safety is minimal. As they judged they believe that the chance of involvement for safety is helping to develop their safe behaviours.

The factor unsafe condition of the organization is seen both cases as a contributory factor for their reported accidents such as uneven floors, damaged floor. Case A mentioned that an employee fallen down from the working platform to the floor due to unsafe condition if the organization. Further as mentioned by case A experts,, safe working environment is always helping to make positive attitudes of their employees in order to develop their safe behaviours.

Commutation system, age and experience also presented in both cases as a contributory factor for their reported accidents in last 05 years. Experts' vision is to see a better culture towards safety.

4.7 Discussion

4.7.1 Types of accidents relating to printing industry

The main objectives of this research were to find out types of accidents in relating to the printing industry and find out contributory factors for employee unsafe behaviours which can be supported to cause accidents in printing industry.

Findings of these two cases showed that common types of accidents in printing industry. When conducting depth discussion, and reviewing of accidents analysis reports, it was founded that some of accidents are depending on each cases' behaviour such as their technologies practices. However, according to the cross case analysis findings which are applicable to types of accidents, it could be clearly demonstrated slips and fall, trips and fall, chemical related accidents such as chemical spillages, contact with hazardous substances, unsafe handling tools and accessories, manual handling related accidents and fallen down from height and machinery related accidents are applicable to printing industry. HSE Executives (2011) also highlighted above mentioned types of accidents such as fallen down from height, slips and fall, manual handling, contact with moving machinery related accidents are relevant to the printing industry. Further they mentioned slips and fall related accidents and manual handing related accidents' contribution were higher than other types of accidents. Scott (2005), Yilmaz et.al (2015) also added trips and fall, chemical related accidents to the types of accidents for the printing industry.

Hence finally it can be concluded types of accidents to the printing industry as mentioned in figure 4.3 named under types of accidents relevant to printing industry.

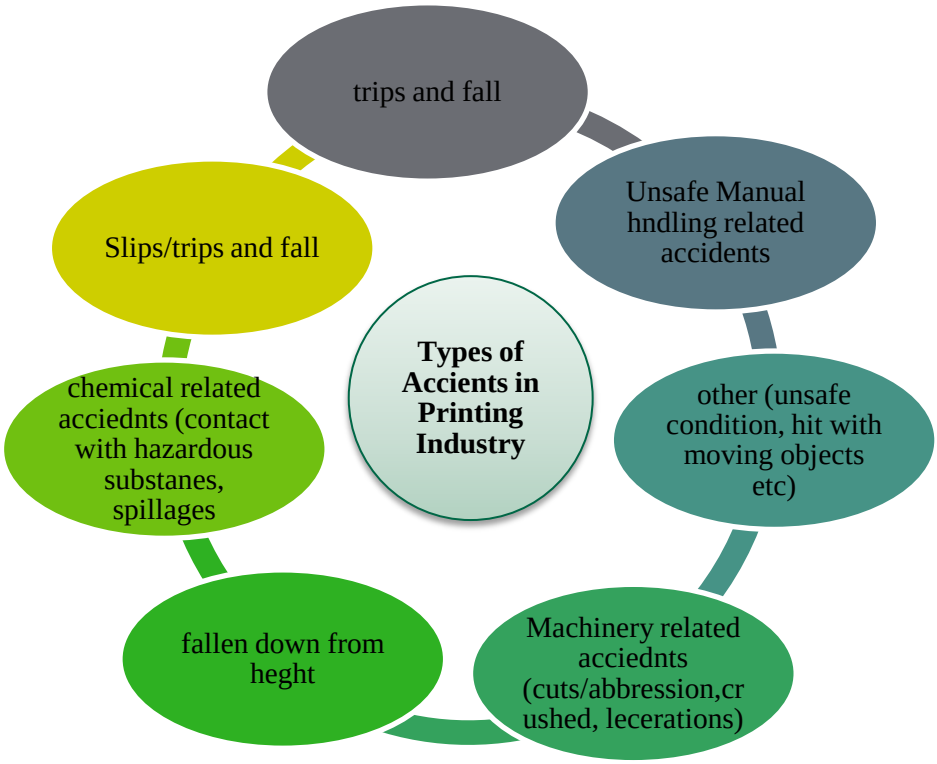

Figure 4: 3 Types of accidents in printing industry

4.7.2 Behaviour based safety factors for accidents in printing industry

According to the accidents details and their behaviours, it is clear that most of accidents have been recorded due to employees' unsafe behaviours. It could be clear with the accidents due to slips and fall/ trips and fall, unsafe handling of tools, machinery related accidents, unsafe handling of chemicals etc. Based on interviewers' both semi structured and management' details, it is clearly the mentioned statement that contributory factors are directly link and influence to their employees' unsafe behaviours and accidents.

During the literature survey it has been recognized that some common factors affecting to employees unsafe acts and accidents. Using of those common factors, it was easy to find contributory factors for reported accidents in printing industry referring last 05 years accidents records conducting with semi structured interview.

Those factors are validated by industries management as most contributory factors which can be contributed for unsafe behaviours in printing industry worker and for cause accidents as showed in below figure 4:4. Here those identified factors could be categorized under main three categories.

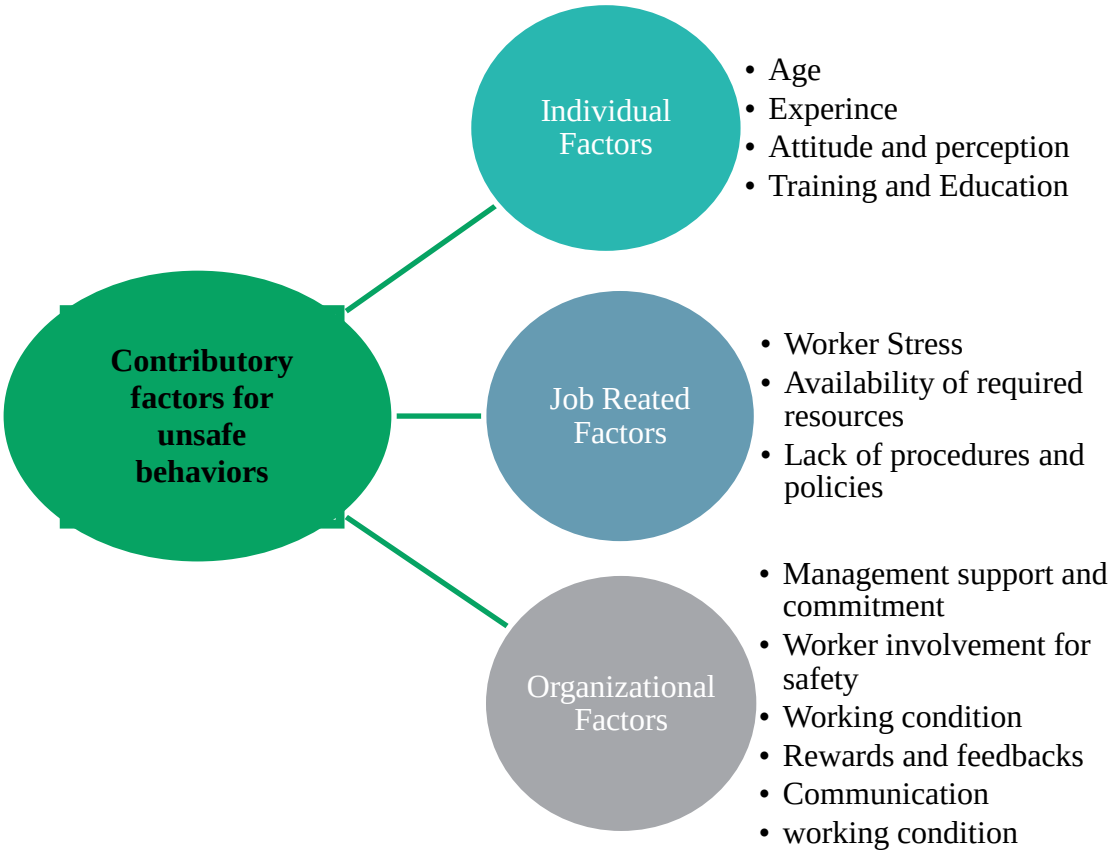

Figure 4: 4 contributory factors for unsafe behaviors of printing industry in Sri Lanka

1. Job related factors

1. Worker stress

Lundstrom, Pugliese, Bartley, Cox, & Guither, (2002) mentioned that work stress is leading to cause occupational illness and injuries. Above two cases' responders are highlighted that pressure for work/job stress may lead to cause accidents. During the experts' discussion, it can be given a conclusion of work with stress always tried to follow shortcuts and work in beyond the procedures. It is truly to accept that work

stress is supported to causes accidents in printing industry and support to cause unsafe behaviours of employees.

Hence as mentioned by both cases all experts, they are planning to minimize the work pressure through providing supportive working environment such as effective utilization of worker skills, implementing rewarding system, effective planning of work, improve relationship in between manager/supervisors and co worker will help to improve safe behaviours of employees.

2. *Policies and procedures*

Adequate and accurate safety related policies and procedures factor will make a difference to safety culture. Employee's poor perception on managers and owners of the organizations fulfilment to safety requirements could lead to negative behaviour and link with poor safety performance which carries huge negative consequences to the individual and the workplace where they work. As per the both cases experts feedback relating to the policies and procedures, researcher could pointed up availability of guidelines such as safe operational guidelines, procedures such as hazard analysis (risk assessments) and policies will make better behaviour environment among workers and will help to reduce accidents.

3. *Availability of resources*

Both cases highlighted lack of availability of resources are affecting to employees' unsafe behaviours and lead accidents. Safe tools and equipments refer documents such as policies procedures guidelines will help to improve employee motivation towards safety.

2. Individual Factors

1. *Negative attitude and negative perception of employees*

Both cases' experts validated that employee negative attitude and their negative perception for safety is facilitating to workplace accidents in printing industry. As

per the all experts' conclusion poor personal attitude for safety is one of the leading factors to cause unsafe behaviours and support to do accidents.

Fulfilling above statement Lundstrom, T al el. (2002) mentioned a strong safety culture is always associated with positive attitudes among employees which can influence the adaptation of safe behaviours and help to reduce accidents and injuries. Hence experts pointed out that to implement a system to get employee involvement for safety related activities and dividing responsibilities will help to make a positive perception.

2. *Age and experience*

During the discussion and the literature survey it was founded the factor; age and experience of workers are directly link with their unsafe behaviour and causes accidents. Equal statements are mentioned both authors as Osward. D. (2016) highlighted that there is a correlation in between worker age and the accident rate. Fang et al., (2004) mentioned that employees experience can be influenced for safe or unsafe actions on site and involvement in safety management system. So providing more knowledge with experience will lead to enhance positive behaviours and reduce accident. Since the employee age also link with accidents need to think about employee age and their experiences when allocating tasks. Another need to provide well experienced workers to young age less experienced workers to get knowledge through onsite trainings.

3. *Training and education*

Both cases employees and experts were highlighting the factors training and educations for safety is directly link with behaviours of employees and reduce accidents. All accepted that their knowledge for safety is minimal and due to the job stress, they could not get a chance to refer safety related documents, could not chance to participating training and awareness sessions, could not discuss safety matters for enhance their knowledge. Further due to the behaviours of accidents in both cases they accepted that lack of sufficient training and education is one of the latent variables leading to unsafe acts or human failures.

It is important to consider the factor age and their knowledge when scheduling and design the training for a specific group. Ghani et al., (2010, smail and zin 2011) efficient safety related trainings are vital to enhance employees' educational level on possible of accidents, how to prevent accidents and catch up hazards involved in their jobs.

Hence, training and education programs play an important role in improvement of safety and important to increase safety awareness and change employees behaviours.

3. Organizational factors

1. *Management support and commitment*

This is another most important factor which can contribute to reduce workplace accident by improving employee behaviours. Above described two cases clearly mentioned that they are expecting good contribution from the management to enhance their behaviours towards safety and it will help to reduce industrial accidents. Proving the statement it could be found Hee. O.C, (2014) mentioned that importance of leadership support for the improvement of safe behaviours of industrial employees.

"*Leadership support is an important element to form the foundation of safety culture. Management must believe that workplace safety is a value to the organization. It is indeed a shared organizational value that fostering worker's ownership of safety without compromising quality or productivity of the organization. In fact, workplace safety improves productivity as workers performing their duties in a hazard free working environment. Therefore, managers at all levels need to demonstrate their support especially in participating safety activities".*

Further the author mentioned that management participation in safety related activities are crucial to show they are always with employees to provide support and motivation.

2. *Worker involvement for safety*

Worker involvement for safety is another most important factor to enhance safety behaviours of employees in order to reduce accidents. As per the two cases feedbacks and previous researches details, active worker involvement for preparing safety guidelines, risk analysing, and monthly/weekly meeting for sharing employee ideas for the improvements of safe culture will make complacent employee will help to create safe work environment. Hee (2014) declared managers need to look into their workers feedback to elevate the safety standard in the organization. Managers have to lead all safety initiatives by personally involve in safety meetings.

3. *Communication*

Communication is another vital factor as identified through literature survey and through the case studies which can influence employee behaviours and link to workplace accidents. Top down communication is more effective to develop worker behaviours. As mentioned workers need to share their views and ideas with the management. It means conducting of regular meetings daily safety walks with management will help to share both parties ideas and develop better relationship. As per the Eskandari at.el., (2017) managers and workers in both formal and informal settings regularly discuss their expectations and subject matters, all team members have a better understanding of the condition of the working relationship.

4. *Review and feedbacks*

Review and feedbacks factor is another most significant factor which is affect for employees' behaviour. For the reason that, employees always are expecting feedbacks for their performances, their reported near misses, accidents reports etc. Those feedbacks always support to change employees' behaviours as well as create to make motivated employee for safety. This will help to reduce industrial accidents.

5. *Condition of the organization*

Another most important factor for causes of accident is unsafe condition of the organization. That is true unsafe act and unsafe condition is making accidents. Further unsafe condition is helped to despondent employees. As a result employees' satisfaction is going down and they are trying to ignore good practices. The un happy employee always makes unsafe behaviours.

Reviewing of all describes factors and effective addressing those gaps will help to improve employees' behaviours in the direction of safety culture and reduce accidents.

4.8 Chapter Summery

In this chapter mainly illustrated that data analysis to find out BBS approaches to reduce accidents in printing industry. Basically these findings could be firmed up as per the compute behavioural factors which are contributory to cause accidents, and the results described how to effectively address those contributory unsafe behavioural factors to use reduces accidents. Content analysis and cross case analysis findings were leaded to get final conclusion.

CHAPTER 05

CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Printing industry in Sri Lanka is one of large scale business entity. Printing presses are varying by its type and size, ranging from fairly simple press to large complex printing presses currently use for printing newspapers, magazines and books. Printing packages, money, stamp and other labels, clothes, cartoons are some of types of printing industry available in Sri Lanka. Even though printing industry is consider under small scale category, from a global perspective, this is one of the key sectors of the world economy with an ever increasing market share gain year on year.

Hearing of work related accidents/injuries and incidents are rapidly increasing. Reason for work related accidents can be illustrated as because of poor awareness for the subject and experiences or poor training facilities or lack of management or unavailability of required resources including safety procedures or unsafe conditions of workplace and/or human errors leading to negligence and carelessness.

Workplaces are becoming aware of the requirement of a work environment that is not only free of common injuries but one that also protect employees, facilities and the working environment from the consequences of occurring accidents/incidents. Considering of human sufferings and economical loss due to accidents, it is becoming imperative on the duty of everyone to prevent accidents by evaluating the reason for accidents. Accident prevention does not lie on work outing safe machines, systems alone but also on improving knowledge, skills, attitudes and behaviours of individual workers.

When evaluating the causes of accidents, often these causes identified as either unsafe condition of the workplace or unsafe acts/unsafe behaviours of humans. Chen & Tian (2012) pointed out that based on the Heinrich judgements reason for 88% of work related injuries were human beings lack of care for their behaviours. Further his

end results specified as there were possibility to prevent 98% of work related accidents and control through their activities. Hence it is vital to effectively addressing human unsafe activities to prevent and control industrial accidents.

Safe behaviour of employee is one of core factor which is helping to reduce work related accidents/injuries and circumlocutory influencing to the final output of the event prior to the injuries or accidents happened. It can be presented here the method of BBS is the most effective method that can be use to effectively addressing to individual's risky conducts and in the meantime enhances workplace safety performance.

The schedules of Behavior based safety are consisting of enhancing employee knowledge through adequate training for safe and their unsafe activities, efficient examinations with reporting of embedded behaviors, discussion findings with workers who are done unsafe activities get suggestions to make them positive at the workplace in order to enhance their safe behaviors and reduce accidents. Also provide rewards to give confidence for the changes to positive attitudes and activities.

This study was intended to discuss BBS approaches to use as a tool to reduce accidents in printing industry. Due to the lack of support from organization top management and the lack of knowledge relating to importance of behavior of employees to run the safety culture, they could not get maximum benefit to develop safety environment with reducing accidents. To mitigate this matter, this research problem was drafted six main objectives as discussed in the chapter one – back ground study.

According to the sequence of objectives, first two objectives were to identify behavior of printing industry, types of accidents in printing industry, unsafe behavior of employees, contributory factors for unsafe behavior of employees and the concept of BBS. The chapter two has been developed to critically review the literature to achieve these objectives. Commonly seven types of accidents relating to the printing industry were identified such as, slips and fall, trips and fall, manual handling,

machinery related – contact with moving parts, fallen down from height etc. During the reviewing of the human errors – unsafe behaviors, it could be identified factors which are contributed to employees' unsafe behaviors which can support to cause accidents. Using those all identified factors, created a common model of factors which could contribute for their unsafe behaviors under main three categories. In addition, it could be positively identified the concept of BBS, elements, positive and negative feedback for implementing BBS and different application of BBS.

As the third objective, accident analysis reports were reviewed in two selected cases to identify types of accidents relevant to the printing industry genuinely. During the review it could be recognized accidents slips/trips and fall is the most common and highest no. of accident in both cases. Additionally, ergonomic related accidents, chemical related accidents, machinery related accidents etc could be pointed out.

The results achieved through identifying contributory factors leading for employees' unsafe behavior through literature survey, semi structured interviews were conducted for selected employees in both cases to identify causes of reported accidents and their judgment for improve employees behaviors in order to reduce accidents. Later than the send semi structured interviews were conducted again four selected experts in both cases to get the validation of each employee's judgments. Content analysis method use basically to analyze recorded data in both cases. Finalized details are analyzed to get final opinion using cross case analysis method.

Based on the final outcomes, employees who are participated for interviews presented that the factor personal attitude and the employee perception towards safety is the most critical factor which is able to influence employees' behaviors. Addition to that, lack of educations and safety related trainings, lack of safety related policies and procedures, lack of management commitment and support, pressure for work, poor upward and downward communication system etc. highlighted as top priority factors which are contributed to unsafe behaviors and as root causes for reported accidents during last 05 years. Finally it could be concluded those identified

contributory factors under main three categories namely individual factors, job related factors and the organizational factors as per the experts view.

Reduction of accidents in the printing industry using behavior based approaches are not a easy task if it is not effectively address to those factors identified through discussion and evaluation. Providing adequate training and enhance employees knowledge for safety, provide the feeling of importance to safe practices, effective management contribution and support, direct communication system with top to bottom level, provide adequate resources to use, effectively worker involvement for safety can be pointed out behavioral factors to improve behavior of employees to reduce accidents.

5.2 Recommendations for further studies

This research is developed to use BBS approaches to reduce accidents in printing industry.

- The final outcome of research as mentioned above recommended applying to different industrial such as textile, different manufacturing sectors in Sri Lanka to reduce industrial accidents since today reporting of industrial based accidents goes up day by day.
- All industries vision is to provide safe working environment to their worker. Hence recommended to find out different processes to apply industries to reduce accidents since today accidents is one of the burning issues daily discussed.

REFERENCES

Accidents in the Printing Industry. (1974). Applied Ergonomics, 5(1), 42. doi:10.1016/0003-6870(74)90258-0

Agbenorku, P., Johnson, O. D., Nyador, E., & Agbenorku, M. (2010). Traumatic injuries among printing press workers in Kumasi, Ghana. Journal of Medicine and Medical Sciences, 19(9), 426-432 . Retrieved from http://www.interesjournals.org/JMMS

Al-Hemoud, A. M., & Al-Asfoor, M. M. (2006). A behavior based safety approach at a Kuwait research institution. *Journal of Safety Research, 37*(2), 201-206. doi:10.1016/j.jsr.2005.11.006

Antonio Galis, A., Hashim, N., Ismail, F., & Mohd Yusuwan, N. (2018). The Factors Affecting Behaviour Based Safety (BBS) Implementation in Oil and Gas Industry. *International Journal of Engineering & Technology, 7*(3.11), 157. doi:10.14419/ijet.v7i3.11.15952

Behaviour-Based Safety (BBS) Study of an Oil & Gas Industry in India. (2018). *International Journal of Engineering Technology Science and Research*, *5*(3), -. Retrieved from www.ijetsr.com

Burrow, A. (2017). A Look at Behavior-Based Safety Program Effectiveness: A Qualitative Study of Participants' Perceptions of Safety Program Effectiveness in a Bayer CropScience's Cottonseed Delinting Plant. Agricultural Communications & Education

Chen, D., & Tian, H. (2012). Behavior Based Safety for Accidents Prevention and Positive Study in China Construction Project. Procedia Engineering, 43, 528-534. doi:10.1016/j.proeng.2012.08.092

Chen, D., & Ren, D. (2015). Behavior Based Safety (BBS) for Accident Prevention and Positive Study in Construction Enterprise. *Proceedings of the 2015*

International Conference on Management Engineering and Management Innovation. doi:10.2991/icmemi-15.2015.10

Choudhry, R. M. (2014). Behavior-based safety on construction sites: A case study. Accident Analysis & Prevention, 70, 14-23. doi:10.1016/j.aap.2014.03.007

Cooper, M., & Phillips, R. (2004). Exploratory analysis of the safety climate and safety behavior relationship. Journal of Safety Research, 35(5), 497-512. doi:10.1016/j.jsr.2004.08.004

Corbin, J. M., & Strauss, A. (1990). Grounded theory research: Procedures, canons, and evaluative criteria. Qualitative Sociology, 13(1), 3-21. doi:10.1007/bf00988593

Cox, S., & Jones, B. (2006). Behavioural Safety and Accident Prevention. *Process Safety and Environmental Protection*, *84*(3), 164-170. doi:10.1205/psep.05186

DePasquale, J. P., & Geller, E. S. (2013). WITHDRAWN: Reprint of "Critical Success Factors for Behavior-Based Safety: A Study of Twenty Industry-wide Applications". Journal of Safety Research. doi:10.1016/j.jsr.2013.07.007

Eskandari, D., Jafari, M. J., Mehrabi, Y., Pouyakian, M., Mirghotbi, M., & Charkhand, H. (2017). A Qualitative Study on Organizational Factors Affecting Occupational Accidents. Iran J Public Health, 46(3), pp.380-388.

ESKANDARI, D., JAFARI, M., MEHRABI, Y., MIRGHOTBI, M., & CHARKHAND, H. (2017). A Qualitative Study on Organizational Factors Affecting Occupational Accidents. *Iran J Public Health*, *46*(3), 380-388. Retrieved from http://ijph.tums.ac.ir

Etienne, J. (2008). Knowledge transfer in organisational reliability analysis: From post-accident studies to normal operations studies. Safety Science, 46(10), 1420-1434. doi:10.1016/j.ssci.2007.10.002

Fang, D. P., Huang, X. Y., & Hinze, J. (2004). Benchmarking Studies on Construction Safety Management in China. Journal of Construction Engineering and Management, 130(3), 424-432. doi:10.1061/(asce)0733-9364(2004)130:3(424)

Fernández-Muñiz, B., Montes-Peón, J. M., & Vázquez-Ordás, C. J. (2012). Safety climate in OHSAS 18001-certified organisations: Antecedents and consequences of safety behaviour. Accident Analysis & Prevention, 45, 745-758. doi:10.1016/j.aap.2011.10.002

Geller, E. S. (2005). Behavior-Based Safety and Occupational Risk Management. Behavior Modification, 29(3), 539-561. doi:10.1177/0145445504273287

Godbey, J. F. (2006). The effects of behavior-based safety techniques on behavior variation, targeted and non-targeted safe behaviors, and productivity and quality in manufacturing facilities. *Auburn university*.

Guo, B. H., Yiu, T. W., & González, V. A. (2015). Identifying behaviour patterns of construction safety using system archetypes. Accident Analysis & Prevention, 80, 125-141. doi:10.1016/j.aap.2015.04.008

Guo, B. H., Yiu, T. W., & González, V. A. (2016). Predicting safety behavior in the construction industry: Development and test of an integrative model. Safety Science, 84, 1-11. doi:10.1016/j.ssci.2015.11.020

Hancock B., Windridge K., and Ockleford E. An Introduction to Qualitative Research. The NIHR RDS EM / YH, 2007

Healey, N. (2006). Analysis of RIDDOR Machinery Accidents in the UK Printing and Publishing Industries 2003-2004 HSL/2006/83. HS Executives . Retrieved from W: www.hsl.gov.uk

Health and safety statistics for the printing industry, http://www.hse.gov.uk/printing/statistics.htm

Hee, O. C. (2014). Factors Contribute to Safety Culture in the Manufacturing Industry in Malaysia. International Journal of Academic Research in Business and Social Sciences, 4(4). doi:10.6007/ijarbss/v4-i4/753

Hoła, B., Nowobilski, T., Szer, I., & Szer, J. (2017). Identification of factors affecting the accident rate in the construction industry. *Procedia Engineering*, *208*, 35-42. doi:10.1016/j.proeng.2017.11.018

Ismail, F., Ahmad, N., Janipha, N. A., & Ismail, R. (2012). Assessing the Behavioural Factors' of Safety Culture for the Malaysian Construction Companies. Procedia - Social and Behavioral Sciences, 36, 573-582. doi:10.1016/j.sbspro.2012.03.063

Jasiulewicz-Kaczmarek, M., Szwedzka, K., & Szczuka, M. (2015). Behaviour Based Intervention for Occupational Safety – Case Study. Procedia Manufacturing, 3, 4876-4883. doi:10.1016/j.promfg.2015.07.615

Jitwasinkul, B., Hadikusumo, B. H., & Memon, A. Q. (2016). A Bayesian Belief Network model of organizational factors for improving safe work behaviors in Thai construction industry. Safety Science, 82, 264-273. doi:10.1016/j.ssci.2015.09.027

Jitwasinkul, B. F., & Hadikusumo, B. H. (2011). Identification of important organisational factors influencing safety work behaviours in construction projects / saugią elgseną statybose veikiančių organizacinių veiksnių nustatymas. *Journal of Civil Engineering and Management*, *17*(4), 520-528. Doi:10.3846/13923730.2011.604538

Khosravi, Y., Asilian-Mahabadi, H., Hajizadeh, E., Hassanzadeh-Rangi, N., Bastani, H., & Behzadan, A. H. (2014). Factors Influencing Unsafe Behaviors and Accidents on Construction Sites: A Review. International Journal of Occupational Safety and Ergonomics, 20(1), 111-125. doi:10.1080/10803548.2014.11077023

Kines, P. G., Andersen, L. P., Spangenberg, S., Mikkelsen, K. L., Dyreborg, J., & Zohar, D. (2010). Improving construction site safety through leader-based verbal safety communication. Journal of Safety Research, 41(5), 399-406. doi:10.1016/j.jsr.2010.06.005

Krause, T., Seymour, K., & Sloat, K. (1999). Long-term evaluation of a behavior-based method for improving safety performance: a meta-analysis of 73 interrupted time-series replications. Safety Science, 32(1), 1-18. doi:10.1016/s0925-7535(99)00007-7

Leiter, M. P., Zanaletti, W., & Argentero, P. (2009). Occupational risk perception, safety training, and injury prevention: Testing a model in the Italian printing industry. Journal of Occupational Health Psychology, 14(1), 1-10. doi:10.1037/1076-8998.14.1.1

Li, H., Lu, M., Hsu, S., Gray, M., & Huang, T. (2015). Proactive behavior-based safety management for construction safety improvement. Safety Science, 75, 107-117. doi:10.1016/j.ssci.2015.01.013

Lingard, H., & Rowlinson, S. (1997). Behavior-based safety management in Hong Kong's construction industry. *Journal of Safety Research*, *28*(4), 243-256. doi:10.1016/s0022-4375(97)00010-8

López-Arquillos, A., & Rubio-Romero, J. C. (2016). Analysis of Workplace Accidents in Automotive Repair Workshops in Spain. Safety and Health at Work, 7(3), 231-236. doi:10.1016/j.shaw.2016.01.004

Lundstrom, T., Pugliese, G., Bartley, J., Cox, J., & Guither, C. (2002). Organizational and environmental factors that affect worker health and safety and patient outcomes. *American Journal of Infection Control*, *30*(2), 93-106. doi:10.1067/mic.2002.119820

Maliha MR, A. M. (2015). Evaluation of Factors Affecting on Safety Performance at High Workplace in Gaza Strip 2014. Journal of Civil & Environmental Engineering, 05(01). doi:10.4172/2165-784x.1000167

Manjula, C., & De Silva, N. (2014). Factors influencing safety behaviours of construction workers. *Accident Analysis & Prevention*, The Third World Construction Symposium2014: Sustainability and Development in Built Environment, Sri Lanka, 45-54. Retrieved from https://www.researchgate.net/publication/317714605

Mehra, D., Kaila, H. L., & Saxena, J. (2017). Behavior Based Safety Approach in Chemical Manufacturing Industries: A Change towards Injury Free Culture. *International Journal of Current Trends in Science and Technology*, *7*(10), 20176-20182. Retrieved from https://doi.org/10.15520/ctst.v7i10.85

Modeling the Factors Affecting Unsafe Behavior in the Construction Industry from Safety Supervisors' Perspective. (2014). *Journal of Research in Health Sciences*, *14*(1), 29-35. Retrieved from www.umsha.ac.ir/jrhs

Mohajan, H. K. (2018). Qualitative Research Methodology in Social Sciences and Related Subjects. Journal of Economic Development, Environment and People, 7(1), 23. doi:10.26458/jedep.v7i1.571

Mohammadfam, I., Ghasemi, F., Kalatpour, O., & Moghimbeigi, A. (2017). Constructing a Bayesian network model for improving safety behavior of employees at workplaces. Applied Ergonomics, 58, 35-47. doi:10.1016/j.apergo.2016.05.006

Mohammadfam, I., Soltanzadeh, A., Moghimbeigi, A., & Akbarzadeh, M. (2014). Factors affecting occupational accidents in the construction industry (2009-2013). Journal of Occupational Health and Epidemiology, 3(2), 88-95. doi:10.18869/acadpub.johe.3.2.88

Oswald, D. (2016). Investigating Unsafe Acts on a Large Multinational Construction Project. University of Edinburgh

Rachman, S., Shafran, R., Radomsky, A. S., & Zysk, E. (2011). Reducing contamination by exposure plus safety behavior. Journal of Behavior Therapy

and Experimental Psychiatry, 42(3), 397-404. doi:10.1016/j.jbtep.2011.02.010

Rahimi Pordanjani, T., & Mohamadzade Ebrahimi, A. (2015). Safety Motivation and Work Pressure as Predictors of Occupational Accidents in the Petrochemical Industry. Health Scope, 4(4). doi:10.17795/jhealthscope-26492

Sadullah, Ö., & Kanten, S. (2009). A Research on The Effect of Organizational Safety Climate Upon The Safe Behaviors. Ege Akademik Bakis (Ege Academic Review), 9(3), 923-923. doi:10.21121/eab.2009319694

Saxena. J et al. (2017). Behaviour based safety approach in chemical manufacturing industries: a change towards injury free culture. International Journal of Current Trends in Science and Technology

Stenson, B. (2016). The 5 Elements of a World-class Behavior Based Safety (BBS) Program: Part 1. Retrieved from https://blog.processmap.com/blog/the-5-elements-of-a-world-class-behavior-based-safety-bbs-program-part-1

Vredenburgh, A. G. (2013). WITHDRAWN: Reprint of "Organizational safety: Which management practices are most effective in reducing employee injury rates?". Journal of Safety Research. doi:10.1016/j.jsr.2013.07.040

Wagner, N. (2017, September 26). Retrieved from https://bizfluent.com/list-6539050-hazards-printing-industry.html

Wirth, O., & Sigurdsson, S. O. (2013). WITHDRAWN: Reprint of "When workplace safety depends on behavior change: Topics for behavioral safety research". *Journal of Safety Research*. doi:10.1016/j.jsr.2013.07.030

Yeow, P. H., & Goomas, D. T. (2014). Outcome-and-behavior-based safety incentive program to reduce accidents: A case study of a fluid manufacturing plant. Safety Science, 70, 429-437. doi:10.1016/j.ssci.2014.07.016

Ying, L., Zhijia, H., & Lianbao, L. (2012). Motivation Mechanism of Accident Prevention in Coal Mine. Procedia Engineering, 43, 174-179. doi:10.1016/j.proeng.2012.08.030

Zamanian, Z. M., Hashemi, H., Azad, P., Mehri, Y., & Kohnavard, B. (2014). Survey on factors affecting occupational accidents among construction industry workers in Khorramabad, Iran. Journal of Occupational Health and Epidemiology, 3(1), 26-31. doi:10.18869/acadpub.johe.3.1.26

Zhang, M., & Fang, D. (2013). A continuous Behavior-Based Safety strategy for persistent safety improvement in construction industry. Automation in Construction, 34, 101-107. doi:10.1016/j.autcon.2012.10.019

Zhou, Q., Fang, D., & Wang, X. (2008). A method to identify strategies for the improvement of human safety behavior by considering safety climate and personal experience. Safety Science, 46(10), 1406-1419. doi:10.1016/j.ssci.2007.10.005

Zin, S. M., & Ismail, F. (2012). Employers' Behavioural Safety Compliance Factors toward Occupational, Safety and Health Improvement in the Construction Industry. Procedia - Social and Behavioral Sciences, 36, 742-751. doi:10.1016/j.sbspro.2012.03.081

APPENDIX

Appendix 01

Interview Guideline for Semi Structured Interview

Project Title: Case study of Behaviour Based Approach to enhance safety inPrinting Industry

Name of the Researcher: Ruwanthika Rathnayake

Section 1: Overview

Even most of organizations have been implemented good safety culture, the reporting of accidents/injuries and incidents also rapidly increase in recent years in Sri Lanka especially in printing industry. Analyzing of accidents data it could clearly understood as root causes for accidents are mostly affect unsafe behaviors/unsafe acts.

The research effort will be to implement Behavior Base Safety Culture to reduce accidents in printing industry

Section 2: Taking Part in This Research

You have been selected as an interviewee of this study. Yet, taking part in this study is voluntary. You will need to engage with a face to face interview with me for ½ hour. Interviews will be recorded as notes.

Section 3: Confidential Statement

Your participation and all the information you provide will be kept strictly confidential. The information provided by you will be anonymised and an ID number will be used to identify your data. The data will be kept until the end of the project.

Section 4: Contact Details

Please contact me, Ruwanthika Rathnayake for any further questions via,
rmruwanthika@gmail.com
+94 7 68232788

Section 5: Consent

| --- | --- | --- |
| Name of Participant | Signature | Date |

Details of Interviewee

Name/ Emp n of the Interviewee	
Designation and Organization	
Educational Qualifications	
Working Experience	

Accident/injury/incident Associated with the Job

1. Can you briefly explain your job role?
2. Have you ever faced any accident/injury/incident while performing your job?
   2.1 If yes, may I know them?
   2.2 Do you believe that they happened due to your unsafe acts/behaviors?
   2.3 If yes, can you briefly explain the incident?
   2.4 If not, may I know the reasons for those hazards?
3. In addition to them, are there any other possible accident/injury/incident that can be encountered when performing your role?

Accident/injury/incident Control Procedures

4. Do you have a risk evaluation and safety system for your job role?
   4.1 If yes, do you follow the controls that have been mentioned there?
   4.2 If you do not follow, why?

Safety Culture

5. Have you ever heard the concept called site safe culture?
   5.1 If yes, what does that mean to you?
6. Do you believe that, you have been provided sufficient safety measures to perform this job role?
   6.1 If not, can you recommend further safety measures that you require?

Thank you for the kind cooperation

Appendix 02

Interview Guideline for Experts Interview

Project Title: Case study of Reducing Employee Injuries through Behavior Base Safety in Printing Industry

Name of the Researcher: Ruwanthika Rathnayake

Section 1: Overview

Even most of organizations have been implemented good safety culture, the reporting of accidents/injuries and incidents also rapidly increase in recent years in Sri Lanka especially in printing industry. Analyzing of recorded accidents data, it could clearly understand as root causes for accidents are mostly affect employees unsafe behaviors/unsafe acts.

The research effort will be to Implement Behavior Base Safety Culture to reduce accidents in printing industry

Section 2: Taking Part in This Research

You have been selected as an interviewee of this study. Yet, taking part in this study is voluntary. You will need to engage with a face to face interview with me for ½ hour. Interviews will be recorded as notes.

Section 3: Confidential Statement

Your participation and all the information you provide will be kept strictly confidential. The information provided by you will be anonymised and an ID number will be used to identify your data. The data will be kept until the end of the project.

Section 4: Contact Details

Please contact me, Ruwanthika Rathnayake for any further questions via,
rmruwanthika@gmail.com
+94 7 68232788

Section 5: Consent

| --- | --- | --- |
| Name of Participant | Signature | Date |

Name/ Emp no of the Interviewee	
Designation and Division	
Educational Qualifications	
Working Experience	

Accident/injury/incident Associated with the Job

7. Can you briefly explain what are accidents reported in the work place during last 5 years?
   7.1 Do you believe that they happened due to your unsafe acts/behaviors of employees or any other reason?
8. If you are believing it is because of unsafe behaviors, Can you identify affected factors for those accidents
9. As you believe can you explain what are the failed areas to address to implement good safe behavioral culture
10. What is your statement for behavior based safety culture in order to reduce workplace accidents?
11. Have you ever try to buildup behavioral safety culture in your organization
    11.1 If yes, may I know how you tried/ what are the areas you tried to develop
12. As you can understand what are the areas you need to thoroughly address/ develop to implement behavior based safety culture to reduce workplace accidents?

Thank you for the kind cooperation