

**ROLE OF CHEMICAL INDUSTRY IN FIRE SAFETY MANAGEMENT IN BANGLADESH:  
A CASE STUDY IN OLD TOWN DHAKA**

By

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A thesis submitted to the Department of Architecture in  
partial fulfillment of the requirements for the degree of Master in Disaster Management

Postgraduate Programs in Disaster Management (PPDM)  
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October 2022

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It is hereby declared that

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2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
4. I have acknowledged all main sources of help.
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Signature

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## Approval

The thesis titled “Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in Old Town Dhaka” submitted by Khairul Anam (ID: 19168002) of Fall, 2022 has been accepted as satisfactory in partial fulfillment of the requirement for the degree of Master in Disaster Management on October 13, 2022.

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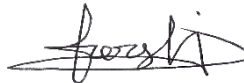
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## **Acknowledgement**

Primarily, I would want to express my heartfelt thankfulness to God, the Almighty, for his only given grace to me to this study, which manages everything effectively. This study would not have been possible without the assistance and support of several individuals. I am deeply appreciative and will always remember them.

Primarily, I would like to express my gratitude to my supervisor, Professor Dr Md. Humayun Kabir, Department of Geography, University of Dhaka. I would like to convey my heartfelt gratitude to Muhammad Ferdaus, Lecturer and Program Coordinator, Postgraduate Programs in Disaster Management at BRAC University, for his assistance and guidance. This work is the culmination of my research supervisor's attentive supervision. I passionately believe in self-confidence and self-strength, which drive us to broaden our horizons and believe in ourselves; I am grateful to our teacher Muhammad Ferdaus for instilling these values in us. He directed me to study with clarity and to study properly, adhering to all relevant requirements. I really thank him for his exceptional ability to transform knowledge. I would like to thank every author, factory owner, government employee, and other person who assisted me with my research.

It is natural for humans to forget; nonetheless, a few names should not be forgotten. Please accept my apologies for my forgetfulness. Finally, I am grateful to my parents and wife, who have been a source of inspiration for all my works and accomplishments.

## **Abstract**

Rapid urbanization and unplanned city planning has become a genuine issue in recent decades. The situation is much worse in the Old Dhaka area of Dhaka South City Corporation. Despite of having narrow road, high population density, faulty city planning, illegal land acquisition, it is a commercially key area where no demarcation is seen among the residential, commercial, and industrial area. Corruption, nepotism, and absence of proper regulatory mechanism open the door for non-compliance of fire safety rules in the chemical industries of Old Dhaka and every year a huge loss of lives and financial assets are seen due to frequent fire incident.

The purpose of this research was to explore the knowledge of fire safety management among chemical industry workers and authorities, evaluate the existing fire hazard management system in the chemical industries and make a substantial addition to academia by investigating the challenges in implementing a proper fire safety management system in chemical industries and recommend solution for them.

This study used mixed approaches to collect data, where quantitative data was collected through interviewer administrated questionnaire survey among purposively selected 157 participants and qualitative data were collected through 10 KIIs and three focus group discussions.

The study results show that the overall knowledge of employees on fire safety is 68.20%, while the overall compliance of industries is 64.28%. High population density near industrial area, inadequate supply firefighting equipment, corruption, irregular monitoring to industry compliance by the respective authority and fragile water & electricity connection contribute to the non-compliance with the industry building code for the chemical industries. It leads to elevated risk of industrial accidents in Dhaka South City Corporation causing unbearable losses of human lives and properties every year. By shifting chemical industries outside of Dhaka City and raising awareness among the owners and employees in these industries, fire incidents can be reduced.

To reduce the risk of fire and property damage in the chemical industrial region, this study recommends raising awareness among workers and owners, effective government policies, financial assistance from the government, and compliance with the RAJUK building code. Fire safety can be made more affordable and high-quality for the public by adding full-time and reserve firefighters and including the chemical sector in fire safety management through contracts and subscriptions; the government can then reduce the enormous costs associated with fire incidents.

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## **List of Acronyms**

DSCC	- Dhaka South City Corporation
FSCD	- Fire Service and Civil Defense
IDI	- In-depth Interview
KII	- Key Informant Interview
FGD	- Focus Group Discussion
BBS	- Bangladesh Bureau of Statistics
RAJUK	- Rajdhani Unnayan Kartripakkha
BFSCD	- Bangladesh Fire Service and Civil Defense
RMG	- Ready Made Garments
BBC	- British Broadcasting Company
ABC	- Australian Broadcasting Corporation
BCIC	- Bangladesh Chemical Industries Corporation
CID	- Crime Investigation Department
BILS	- Bangladesh Institute of Labor Studies
PDCA	- Plan-Do-Check-Act
PRC	- Professional Regulation Commission
HAZOP	- Hazard and Operability Analysis
SCL	- Safety checklist
CISF	- The Central Industrial Security Force
DG	- Director General
NFPA	- The National Fire Protection Association
ICMA	- International City Managers Association

## Chapter One

### Introduction

#### 1.1 Introduction & Problem statement

As a disastrous event fire can be originated from natural or human activities occurring anywhere inflammable materials are present which can cause huge loss of human lives and properties if not controlled in time (Haque, 2001). A mega city with such small area and result of rapid urbanization without systematic plan, Dhaka South City Corporation (DSCC) is prone to fire hazards. Fire service data show at least 468 fire incidents struck the old town's Lalbagh, Hazaribagh, Sadarghat and Siddique Bazar, where more than five hundred chemical warehouses and factories operate illegally (Daily star, 2021).

These unplanned chemical industries are a double burden in DSCC and these are the reason of one of the biggest fires in the history of the country took place on 3 June 2010 in Old Dhaka's Nimtali. At least 124 people were killed in that devastating fire at a chemical warehouse (The business standard, 2021). Another huge tragedy was the Chowk Bazar fire incident on February 20, 2019.

A road accident between a pickup vehicle and a chemical car ignited the fire. The car's gas cylinder exploded after the incident. The fire then moved to a series of buildings used to store chemicals in Old Dhaka's densely packed historic quarter of Chowk Bazaar, soon spreading to surrounding buildings. At least eighty individuals were killed in the fire, with another fifty injured (BBC, 2019).

Old Dhaka is a hub of chemicals, plastics, cosmetics, rubbers, and nail polish in residential complexes. This makes an ideal situation for a fire to take place. One of the most vulnerable areas in DSCC is ward thirty-four, which is a residential area but 50% of the area is used for commercial, educational, and industrial activities where many of them use highly flammable ingredients as raw materials.

According to Fire Service and Civil Defense (FSCD), most of the fire events ignite from chemical, leather, and shoe factories due to using chemical and glue which are overly sensitive to fire. Besides, buildings located nearby to these sources are considered as highly vulnerable to fire events (Rahman & Rahman, 2017). Most fire occurrences happened in Siddique Bazar, resulting in property losses of Tk 1.97 crore, followed by 160 incidents in Hazaribagh, resulting in property losses of Tk 1.42 crore (The Daily Star, 2021).

The fire department did not give any licenses for putting up chemical factories or warehouses in the area after the 2010 Nimtoli catastrophe, which was the country's deadliest fire disaster, killing at least 124 people (The Daily star, 2021). However, after a recent survey conducted by fire service, the department produced a set of recommendations, including immediate relocation of the chemical stores and shop from residential areas to a safer place. Unfortunately, no effective measures have taken place (The Daily star, 2021).

There is a gap of knowledge about what the chemical industry/storage owners and workers know about fire safety management in a highly dense area like DSCC. One of the most important challenges regarding fire safety is access to roads. Fire control equipment cannot reach people only because of lack of access road. The field observation states that structures having access road at least 10 m distance provide them the opportunity to get escape from their place but only presence of access road does not represent low fire hazard vulnerability (Rahman & Rahamn, 2017).

It is evident that other challenges also exist in implementing fire safety measurements. Therefore, it is important to understand industry owner and worker's knowledge about fire safety management as well as the challenges regarding implementing proper management system. This may lead us to a proper recommendation on how to solve this critical problem.

## **1.2 Significance of the study**

Chemical industries are not intended to replace existing emergency response mechanisms that exist such as the Bangladesh Fire Service and Civil Defense or Bangladesh Army; they are

instead designed as an initial response team for the immediate aftermath of an emergency until professional emergency crews arrive.

This study has added a significant contribution in the academic field by providing scientific documentation of the possibilities of partnership between Chemical industries and suggested policy recommendations for eradicating the barriers in Chemical involvement in the fire safety management in Bangladesh.

### **1.3 Research question**

The main research thrust of this study was

- How efficient chemical industries fire safety management is in tackling fire incidents in Bangladesh?

### **1.4 Research objective**

The objectives of this study were

- To explore the knowledge of fire safety management among chemical industry workers and authorities.
- To evaluate the existing fire hazard management system in the chemical industries.
- To investigate the challenges in implementing a proper fire safety management system in chemical industries and recommend solution for them.

This study has led to understand the gap of knowledge in various aspects of this problem. It will enlighten us with the idea of what knowledge is lacking in industry workers and owners, how the challenges can be managed, what short-term and long-term solutions can be suggested for decrease the problem.

### **1.5 Scope of the research**

The study had only focus on the chemical industries role in fire safety management in Bangladesh. The reasons behind choosing chemical industries are frequent fire incident in chemical industries in recent times, most unplanned and under monitored industry that has an

enormous impact in our economy and development, concentrated in a particular area of Dhaka which can be easily covered under a brief period.

### **1.6 Limitations of the study**

A significant limitation of this study was the scarcity of time allocated the owners and other responders for undertaking the survey and interview in the chemical establishments. Accessing the chemical establishments was highly risky and difficult. Access and availability of fire safety related documents considering the chemical industries in this Asian context was a matter of paradox as well.

## **2.1 Introduction**

Fire is one of the major reasons for loss of both life and property at every industry. This unwanted scenario of fire attack creates more volatility in chemical industries especially. The presence of chemicals; mostly easy to flame can cause for toxic fumes, dense fog, exothermic reaction or, slippery floors and even blocking water drainage interrupts the effectiveness of fire safety actions creating a total massacre indeed. Thus, a prescribed, expert driven fire safety mechanism is expected at all costs. In doing such- both different countries at national level & different chemical industries at individual level initiated a few leaders' similar guidelines and set fire safety preparedness indicators.

## **2.2: Recent Major Fire Incidence of Bangladesh**

### **2.2.1 Case study 1: Chawkbazar blaze, 2019**

The densely packed Old-Dhaka bound district of “Chawkbaar” faced the massive fire covering an entire locality halted after a total death of eighty where, another fifty were admitted into Hospitals. The fire caught the attention of international media after, “February 2019 Dhaka fire”; A sequential disaster in the same territory from apparently the same reason-the Nimtoli fire of 2010.

Headline reads in “Aljazeera- February 20<sup>th</sup>, 2019; “Huge fire kills scores in old part of Bangladeshi capital Dhaka” (Al Jazeera, 2019). Explosion of a compressed natural gas cylinder of a vehicle facing accident caused the entire accident. The fire quickly expanded among other vehicles & then the apartments. A sequential explosion started as those apartments were used for both residential and chemical storage purposes, violating the government rules of fire safety. A packed traffic jam in those narrow lanes left the mass with no escape, leaving such rate loss.

According to “ABC News” (February 21, 2019), the fire service department responded that the illegal chemical stores in ground floor of most apartment fueled the fire for almost 10 hours. Fire fighters had to make struggles to reach water supply amongst such crammed buildings.



According to BBC (February 21, 2019), Ministries of both Home & industries initiated separate committees for investigation separately. Repetitive fire at this locality pointed that no significant steps have been taken in years since the Nimtoli accident of 2010; whereas the investigation committee suggested a permanent withdrawal of chemical storages from the residential area. Such indifference attitudes towards the fire safety issues left the locality- vulnerable to extraordinary deadly disasters in near about and on.

### **2.2.2 Case study 2: Fire accident at Armanitola, 2021**

Fire broke out on a residential apartment named, “Haji Musa mansion” at Armanitola, old Dhaka on April 29<sup>th</sup>, 2021. Allegations rose against the owner of the complex for his unlicensed storage of chemicals on the basement. From the primary investigation it has been found that, the owner illegally stored chemicals without licenses from both city corporation and fire services department. Thus, a case has been filed against with charges of illegal procession and negligence.

According to Dhaka Tribune (April 29, 2021), the death toll reached six where another thirty-five others were admitted in the Hospitals. Chemicals turned out as fuel to this incident that the fire services department responded that nineteen units of them brought the blaze under control by almost 2 hours. Failure, indifferences of government actions resulted in such casualties where the call for relocating chemical stores from old Dhaka still goes unheeded.

### **2.2.3 Case study 3: Fire accident at BSCIC industrial estate, 2021**

Fire engulfed a chemical factory in BSCIC industrial estate on November 26<sup>th</sup>, 2021. The factory is located at Sagarika, chattagram just a half mile from the Zahur Ahmed Chowdhury Cricket Stadium. The devastating fire was put out by a combined effort of several fire service units by an hour. According to BDNews24 (2021) a national online newspaper, the factory stored barrels of liquid chemicals explosion of which sequentially which fueled the fire. However, cause of the fire remained unclear. The owner of the factory claimed that electrical short-circuits could be the reason for the accident. Fire Services department assured the news about no casualties from the accident was recorded.

Another fire engulfed a Cumilla BSCIC based pharmaceuticals company on April 7<sup>th</sup>, 2021. Fire services department responded to the national daily newspaper about an injury of eight people in the accident. Cause of the accident could not be known immediately; however, primary investigation directed the chemicals store section could be source of such (The Daily star, 2021). A fire broke at chemical storehouse on November 11<sup>th</sup>, 2021, at Kona Bari BSCIC in Gazipur. Seven units of fire service department combined put out the fire. More than 1500 people were working inside, however No casualties was recorded. (Risingbd, 11<sup>th</sup> November 2021).

#### **2.2.4 Case study 4: Fire at Hashem Food, 2021**

Hashem food & beverage limited, a sister concern of Bangladeshi national brand “Sejan” by Sajeeb group witnessed a fire that took fifty-two lives on July 8<sup>th</sup>, 2021. Headline reads, “Citizens’ probe: Hashem foods factory fire was murder due to negligence.” Based on Nagorik Tadanta Committee (citizen’s investigation committee report) the national newspaper of the country blamed the owners and their negligence as accused of such death role. Though the owners accused workers’ negligence by discarded cigarette but in the primary investigation, an absence of smoke detectors, fire alarm, emergency exits in the Rupganj, Narayanganj based factory.

According to “Reuters” (2021), the six storied building was built without permission from the government and the single exit gate was found locked during the accident so, the workers could not even escape the fire. According to BBC (2021) on July 10<sup>th</sup> reported that, along with the fire safety allegations, a child labor complaint had been reported and was brought under inquiry. Fire services responded that, they found the stairs to roof was locked and there was storage of chemicals, plastics and other inflammable chemicals that fueled the fire near about 24 hours.

Police arrested the owner and Government formed separate committees for fire accident and child labor accusations. However, Bangladesh is still not stranger to any deadly fire as safety standards are still lax. Till last known, CID was handed over with the duty for investigation and a court procedure is being conducted.

### **2.2.5 Case study 5: Fire at ASM chemical industries Ltd, 2021**

Fire engulfed a chemical industry after a massive blaze in Sreepur, Gazipur on February 11<sup>th</sup>, 2021. The misfortunate ASM Chemicals limited is the sister concern of Aziz group, here the whole capacity has been used for storing and producing chemicals. The concerned officials of the factory responded to the National daily newspaper that, explosion from the hydrogen peroxide plant is their primarily suspected source of such disaster (The Daily star, 2021).

Locals responded that, toxic gases from the accident turn the nearby intolerable for more than an hour. Locals claimed about presence of chemical traces and toxic gases from the dug deep tube wells. However, the authority responded such complaints as “baseless.” 1 people died where another seven were taken to hospital for treatment. The ASM Chemicals faced another fire at its chemical warehouse in the November of the same year.

### **2.2.6 Case study 6: Nimtoli Tragedy, 2010**

The widely known 2010 Dhaka fire occurred in the Nimtoli area of old Dhaka killed 124 people, leaving one hundred more at hospitals on June 3<sup>rd</sup>, 2010. The fire started with an explosion of Electrical transformer then spread to the residential and commercial buildings of old Dhaka. Presence of chemicals and other flammable products in the illegal storehouses of those apartments fanned the fire in no time. People became trapped inside the apartment, leaving with no escape to be burnt till death. Affecting a wedding party, the fire exacerbated the casualties. Daily Newspaper recorded the doctor’s response after smoke inhalation directing the trapped inhabitants was the major reason of such death role than that of burnt issues (Jones, 2010).

The Government of Bangladesh with a lead by PM Sheikh Hasina immediately ordered an inquiry committee to look in the accident with announcing a day of mourning. Several organizations coming from national and abroad accused the presence of illegal chemical stores at residential areas of old Dhaka terming it as “Time Bomb.” However, steps against those illegal proceedings are still an issue of mass demand indeed.

### **2.2.7 Case study 7: Dhaka Garments and Washing Limited Fire, 2021.**

On March 6<sup>th</sup>, 2021, a fire in the chemical warehouse of Dhaka garments and washing limited

took one life and forty-two other injured. Headline reads in the national daily, “Dhaka tribune” reported that, though the warehouse was far away from the main factory, but toxic fumes floated through air and was suffocating the workers. The owners of the factory remained reluctant in opening the main gate as workers began to get fainted. However, owners refused to open the exists in the initials. Authentic cause for such fire was found unknown till the report was prepared.

### **2.2.8 Case study 8: Fire at Tampaco foils, 2016**

Tampaco foils fire was worst industrial accident after the rana plaza garments collapse. On September 10<sup>th</sup>, 2016, fire engulfed the packaging factory at Tongi BSCIC in Gazipur. Forty-three people were killed and seven remained missing after the fire. In a conducted case study, BILS- Bangladesh Institute of Labor Studies 2016 asserted that, lack of structural information led the operational disruption of fire services department that ended with the engagement of Army personnel, a delay in the efficiency of rescue mission indeed.

An Investigation Committee run by Tita’s gas- the gas supplier of the factory found that, explosion from the gas pulling booster machine started the fire. Which led to a structural collapse of the building as Netherlands based “Clean Cloths Campaign” reported. Later, police filed a case with murder and other detailed charges against the owner over their negligence about fire safety measures.

In the preliminary investigation, absence of emergency exit points, misinformation, expired structure, owners’ negligence over the gas leakage issues etc. were marked. However, thus repetitive structural collapse and massive death role pointed a doubt about the prospects we promised, and we attained in these post Rana Plaza accident days.

### **2.3 Importance proper fire safety management in chemical industry**

In general terms, Chemical Industries refers to the establishments, like- factories, refineries, tanneries, or others which involves in the chemical production. Traces of basic chemical industries started with the first inhabitants of civilization, only pharmaceuticals were used that time. However, after the industrial revolution, heavy Chemical Industries began journeys in every country. Combining these in chemical industries induced patterns of economic growth, development, and consecutively political changes as well. From converting- oil, gas, metals,

materials like natural resources to various finished products these industries created an employment of more than 120 million populations. In the meantime, international council of chemical associations referred those global chemical industries contributes equivalent to 7% of world total GDP as well (Zou et al., 2022).

Chemicals, the raw material for the chemical industries comes with its unique physical structure of free electron directing the transportability of electricity that turns these industries acutely vulnerable before fire. Fire is a chemical reaction itself. A reaction with materials and oxygen of air (Cheraghi, Bagherian-Sahlavani, and Mohammad, 2018) added that- Because of the working nature at these industries, like- high storage and handling of chemicals, high flow of fluids, hot temperature, process complexity and toxicity turn these always vulnerable before the unwanted catastrophic disasters.

Supporting the statement, (Jaafri et al., 2018) added that, the most frequent causes of accident at chemical industries are of fire and explosion. Chemical toxic dispersion also remains a threat, but The German initiated Accident reporting system, “ZEMA” (Zentrale Melde- und Auswertestelle für Störfälle und Störungen in verfahrenstechnischen Anlagen) in following its records revealed that, fire is that one of the most common causes of accidents at chemical industries in country. Statistics dedicatedly supports such acquisition of ZEMA after several accidents has been occurred at both international and national levels.

At the roots of fire accidents, the flames spread faster which is enforced by the presence of highly inflammable materials like reagents, chemicals, gas cylinders and gas pipelines, available in the industry. If one creates fire, other transports & spread among not affected. These extreme incidents associated with the chemical industry can quickly pave for cascading sequential events that might result in a catastrophic loss indeed. From such frequent causes can consequence possibilities, fire can be termed as major deterring element before the effectiveness and performance efficiency at chemical industries. For that, an introduction to fire safety management is expected as well.

## **2.4 Practice of fire safety management in chemical industries of different countries in Asia**

Asia with its geographical advantage over Indian and the Pacific Ocean produced the prospects of trade and business, especially in the chemical industries. Availability of Natural resources, easy transportation, cheap labor cost attracted investment into the chemical industries in this region. Asian high population, meeting the domestic and regional demand of products, mostly-food, pharmaceuticals, fertilizers, and pesticides which are of the chemical industrial outputs-play an influential role as well.

According to chemical and engineering news- C&EN's global top industrial rankings 2020, industries like- SINOPEC (China), Mitsubishi Chemical (Japan), LG Chem (South Korea), Petrochina (China), Reliance (India), Petronas (Malaysia), Cementhai Chemicals (Thailand) holds the top tire position among the global traders of chemical industries. The congested list of Asian companies in the top one hundred companies supports the statement of industrial flourish in this region itself indeed. The bigger the quantity, responsibility grows higher. As, chemical industries are highly vulnerable and sophisticated business, countries across Asia initiated several fire safety management practices, drafted laws, enacted policies, rules, and regulations. Some few of the mostly notable Practice of fire safety management in chemical industries are asserted as such.

Making more emphasize on preparedness combatting consequences, conceptually- Japan leads chemical industries in this region. "Sumitomo Chemical" is a Japan based chemical industry is cited top twenty-five chemical industry by the C &EN report. According to the safety and security performance assessment report-2021 -Putting safety as to be the topmost priority, Japan formulated a five principle-based safety precautions in common.

These 5-rule remains applicable to both individuals and institutional competencies. The five principles include-

1. Safety and health set as top priority.
2. Identify and resolve safety heath related policies at the source.
3. Implement rules regulations.
4. Safety in mind always, not just in working schedules.
5. Coordinate all previous set rules and terms-conditions, resources and so on.

Mostly companies in Japan, the “Product life cycle calculations” are maintained rigorously to avoid any unwanted contexts and remain prepared to face the unseen and gradually developing. Such as- Japan follows a path of checklist at all stages; from development to manufacture, distribution, usage, and disposal.

Japan also maintains the PDCA model with establishing dedicated high-powered groups, responsible to plan, do, coordinate and act over ensuring safety precautions. Presence of such competencies-built Japan with zero severe accident at chemical industry caused for fire since 2015. Japan also provides on one of kind- “Kiken Yochi Training” -KYT; Hazzard Prediction training and practices of fire accident information sharing across the land indeed (Hashida, Kamezaki, Goto, & Shiraishi, 2016).

China in following the Japanese model of central disaster prevention committee and dedicated training practices, established Ministry of emergency management and a dedicated department of safety supervision and management of dangerous chemicals for chemical safety ensure works in 2018. Unlike Japan, China focused on drafting legal books and principles over the issue of fire safety covering the industrial capacities. In 2002 China initiated the “Work safety law of the PRC” as a mandate of improving work safety existed. The law was later updated in 2014. For safe management of hazardous chemicals dedicated regulations were drafted. Another regulation on safety operation licenses for hazardous chemicals enterprises was initiated in 2012. Codes of instruments were directed time to time as well.

Most prominent ones are in followings-

GB 6944-1986	Classification of hazardous chemicals
GB 50183 -1993	Fire prevention code for crude oil and natural gas engineering design
GB 18218-2009 (revised in 2018)	Identification of major hazard installation for dangerous chemicals

Source- (Chen, 2020)

With a quantitative risk assessment in 20013- China directed “Guidelines on safety inspection

catalogue for chemical enterprises mentioning 40 key inspection contents”. Strategic tools like- Safety checklist (SCL), risk assessment matrix, hazard & operability study (HAZOP) were mentioned in the second guidelines of 2019’s, Guidelines on hazard identification and management in hazardous chemical industries (Chen & Reniers, 2020).

India makes another significant contribution in the era of chemical industries by its mega giants like the “Reliance Group.” Varied from the Japanese and Chinese stand, Indian fire safety management is of more practical one. The Indian central government runs dedicated industrial security forces since 2010. The central industrial security force (CISF) is a dedicated force that is trained for providing both security and risk mitigation assistances, in aid to the Civil defense and fire rescue department.

Apart from the CISF, reliance group formed Reliance securities training facilities for training and grooming industrial safety and security officials. A dedicated era of expertise began. Traces of OHC- occupational health centers were found in literatures directing the infrastructure of Indian chemical industries. Supply chain of resolute fire safety professional to the market of India not only contributing effectively but also pointing Indian motives and sincerity over the security demands. Major number of Indian chemical industries been traced where they follow- “Safety data sheet and Chemical safety assessment” (Fernandes & Mulimani, 2021).

The presence of the “Code of practice for fire safety of chemical industries-1985” demonstrates Indian standards dedicatedly formatted for the chemical industries. Moreover, industries of this region draft standards on industry basis centrally.

The code describes standards through categories like-

<b>Location</b>	Open space and minimum thirty meters away from public buildings
<b>Plot layout</b>	Must be six meters wide road available for movement of fire engines
<b>Electrical installation</b>	As per the code of 1982
<b>Storage</b>	Single storied building, far from production house.
<b>Inventory</b>	Minimal quantity can be stored at workplace.
<b>Construction types</b>	Three types of construction for Manufacture, utility, and go-down purposes

Source- Indian Code of practice for fire safety of chemical industries-1985.



Lastly, the contemporary Bangladesh scenario comes with some different scenario. Initiation for the Fire safety education is proposed recently in late 2021. There is a market absence of Chemical fire safety service providers in the country. Bangladesh is still following the dated ‘The East Pakistan Fire Services Ordinance, 1959’ & ‘The East Pakistan Fire Services Rules, 1961’ which are not combined effectively with the National Building code.

A non-cooperative administrative culture in service resulted after availability of scopes to avoid government set regulations. The “Fire Protection and Extinguishing Act, 2003 gives the power to Bangladesh Fire Service and Civil Defense Authority, however not convenient with time demand as well. At present, Bangladesh Fire Service and Civil Defense Authority is hold responsible for providing license for warehouse or workshop that stores the combustible Ingredients (National portal of Bangladesh).

### **2.5 Capacity of Bangladesh Fire Service and Civil Defense in management of fire incident**

The “Bangladesh National Portal” indicates that- Bangladesh Fire Service and Civil Defense is a disciplined force of the government of Bangladesh that is the solo authority for responding fire crises across the country as well. Headed by a director general (DG) deputed personnel of the armed forces remain dedicated for making the job with a team of trained and experienced officers, fire fighters, divers, and technicians. Bangladesh Fire Service and Civil Defense started its journey in 1981.

In terms of managing the fire accidents, fire station with their locational aspects could make better outputs in practice. For doing such a regular distribution of stations is expected but it hardly meets in practice. From the National Portal the mis-matched distribution of offices can be marked easily in the capital, the northern part and eastern part, new Dhaka where the fire stations lack whereas, the southern part- the old city comes with a concentrated fire station.

Though, these stations of south still hardly can make job in managing fire incidents. This same context applies across the country. Asking about competencies, common lacks departmental capacity organizes after- Fire service is not informed in time or exact location is not given which causes delay of the fire units to reach the spot. Unauthorized constructions, electrical connections lead another challenge indeed.

The Very narrow approach lane or road and contemporary poor road network of Bangladesh can be accused ahead. In the emergency, fire fighters need to reach the accident without making delay, but the poor road networks leading congestion, traffic jam creates a massacre. The fire fighters hardly manage to reach in time. “National Fire Protection Association (NFPA)” set a standard for reaching first response vehicle and full team at 4 minutes and 8 minutes (NEPA, 2022). But considering the conditions of Bangladesh BFSCD set it as ten. Surely a slow response deters the operational performance indeed.

According to the BBS (2011) on “Population and Housing Census-2011”, the ratio of fire fighters per population stood 34,250 in Bangladesh whereas it is prescribed only two thousand by the National Fire Protection Association (NFPA) and the International City Managers Association (ICMA). The shortage of effective manpower results in overpressure among the firefighters.

The very common operational challenges of Bangladesh Fire Service and Civil Defense can be drafted as- complicated road layouts (mostly at old town of Dhaka), narrow access to many incident spots; owing to unplanned urbanization of building violating building code, absence of designated source of water; the scene found pathetic when fire fighters seemed helpless at Nimtali fire blaze -like hazards of Dhaka owing to the absence of water source. Rapid land filling tendencies are leading a complete disaster indeed & manpower shortage. Combined, BFSCD suffers for these commoners.

However, National Daily newspaper the “Daily Star” on September 2<sup>nd</sup>, 2021 reported that, BFSCD is making tremendous effort in enhancing its operational capacities; from men power handling to hiring consultant for recruitment as per the international standards. Yearly statistics of BFSCD directs that, it trained 33,062 volunteers in 2021 with initiating “Fire Safety Manager’s Course” and “Fire Science and Occupational Safety Course”. A fully fledged training academy is about to initiate journey soon as well.

Since Bangladesh is a disaster-prone country and the nature & intensity of different disasters do not care any prediction, the members of fire and rescue department need to be given latest and

modernized training at home and abroad so that they can cope with the forms of disaster. Availability of modernized equipment is another concern here which is under transformation. The occupational capacity of Bangladesh Fire Service and Civil Defense can be defined in the “takeoff stage.” It is facing challenges but as the ongoing initiatives will be implanted, BFSCD will be one, competing fire agencies of expert nations in this sector abroad (BFSCD, 2022).

## **2.6 Literature gap in the study of chemical industries fire safety management in Bangladesh**

The review of National policies, Rules and regulations concerning chemical industry bound fire safety management practices after analyzing the series of chemical industry bound fires revealed that- Bangladesh lacks from legal framework to facilities and workforce achieving efficiency in management. Comparing the essences of fire safety management practices of chemical industries, it has been found that-

Alam and Baroi (2004) initiated their study based on the data of Fire accident that occurred in 2001. They analyzed the fire accidents of Dhaka city through- distribution, causal and temporal patterns. Furthermore, that study developed the fire risk identifying process with means of Fire Risk Assessment Method for Engineering. Islam and Adri (2008) attempted exploring the Dhaka City and its fire hazard vulnerability.

The study assessed annual count of fire accidents and causes. After mentioning the legal aspects of Bangladeshi fire safety management practices, the study expressed the citizenry expectations and revealed the institutional capacity of the fire and rescue department. Jahan, Islam, and Hossain (2018) explored the old Dhaka and examined the chemical shops and warehouses, identifying the fire risk index. The work later distributed the studied chemical shops and warehouses accordingly.

Legal Framework and Regulatory practices of fire safety management in Bangladesh reveals that, the existing each regulatory body has definite and dedicated legislation for own. Lack of coordination among the laws (fire code and building code) brings contradictions in service. Power and exercise overlapping, gaps in regulations can be observed as well. Thus, after continual of variety accidents the context has not changed a bit at all. The contemporary

problems are prevailing as the same. Practice of aged regulations with some lacks can be traced which needs urgent modulation. Like- there is not any single regulation available that address the safe transportation of chemicals yet.

There is also a lack been found that, there is no hazard information sharing mechanism available in the country. In fact, here is an acute absence of such practices indeed. The government hardly keeps data about the total chemical inventory in the country. The Bangladesh Bank keeps monthly export import expenditure that includes the chemical inventories as well. These data are not compiled properly or shared accordingly.

Proper incident investigation and lesson learning is also absent at the national or organization level. Chances of assessing risk remain void. Government also lacked at making efforts in labeling the chemicals. Unlabeled chemicals are thoroughly stored and transported across the country creating repeated massacre, one after another. Process safety is not properly mentioned on the labor act of 2013 as well. Risk assessment and management of safety issue in respect of life and property are yet to be introduced in the county.

Acute absence of skilled workforce and chemical testing facilities turns out as to be of other concerns too. Academia- industrial relations, setting up a National Chemical Coordination Committee, national chemical database, and integrated investigation board like initiatives are expected from Bangladesh as well.

## **2.7 Summery of Literature review**

The literature shows that a few research have been done on fire incidents at chemical industries in Dhaka, Bangladesh. The rest world grew fast with updated practices, rules and dedicated regulations concerning the fire safety issues. However, Bangladesh is struggling here. Lack of updated laws, management practices, and performance standards turn the consecutive fire accidents unavoidable. Repeated accidents are causing both lives and property. However, trends of upgradation are about to emerge. So, the fire safety management practice will be compatible enough for dealing national level challenges indeed. Such improvements will not only decrease the losses but also increase our acceptances internationally.

## **Chapter Three**

### **Research Methodology**

#### **3.1 Introduction**

This chapter contains information about the research methods for the current analysis. It describes the intent of the research and an appropriate form for achieving them. A summary of the techniques used in this section is given in this chapter. This section covered methods of research, population, sampling techniques, data collection, analysis, and the study limitation.

#### **3.2 Research Method & Approach**

The mixed methods research approach has been followed in this research as mixed methods research provides a more complete understanding of the research problem than either quantitative or qualitative alone (Creswell & Plano Clark, 2007). For conducting mixed methods explanatory sequential design has been used where qualitative data were collected based on quantitative data and interpretation was made based on both quantitative and qualitative results.

#### **3.3 Sampling Technique**

Respondent's selection process through Non-Probabilistic Sampling (Purposive Sampling) was made inclusive irrespective of class or caste so that conclusion reached can be authentic. As a fresh researcher, it was hard to get access to the target population because of shortage of time, money, and experience. So, respondents were chosen purposively to get easily access to the information within a limited time. Purposive sampling techniques were used to choose both the survey population and the top managers for key informant interview.

#### **3.4 Sampling Size**

G power software was used to determine the sample size. At medium effect size ( $F=0.15$ ), 80% confidence level and 16 number of predictors, the minimal sample size was 143. To increase the authenticity and reduce the chance of non-response error, researcher took additional fourteen surveys. The total number of the survey population was 157.

Table 1: Sample Size

Method	Types of Respondents	Number
Survey	Chemical factory workers and authorities	157
KII	Fire management officials, Experts	10
Focus Group Discussion	Among the employees of chemical industries	3 (8-10 people in each discussion)

### 3.5: Study Area

Old Dhaka also known as “Puran Dhaka” refers the historic old city of Dhaka; formerly known “Dacca” -the capital of Bangladesh. In the first millennial, the old town was inhabited at first by the Mughals. The pro-industrial Mughals set their industrial hub in this town, later their capital – “Jahangirnagar.” The city was found on the banks of Buriganga, river basing Sadarghat as river port for anchoring water vehicles and business.

From the initial days the city consisted of plain land bounded by three major rivers of the country – the Meghna, the Padma and the Jamuna. Crisscrossed by several streams and other rivers assured easy inbound and outer transportation of the city which attracted the merchants from Central Asia & Europe as well. Sonner, the city became a trade attraction for all for its strategic transportation facilitates and commercial opportunities. Foreign traders started initiating businesses and setting several factories in this area leading towards it making commercial capital role. Following the flow, Dhaka served as capital for British India later Pakistan and now serving Bangladesh (Kabir and Prolin, 2012).

Tropical vegetation and moist soil produced products like- “Maslin, Jamdani, Jute items” with previously established trade prospects attracted increased people into this town creating a massive rural-urban migration in the country. Dhaka is continuing its job, Vibrant culture with increased business opportunities is attracting increased people increasing population, mostly unplanned. At present days, Sadarghat remains the busiest river port in the country covering access to southern Bangladesh on water ways with neighboring ones as well.

Starting as military outpost later, Business- Cultural and Trade hub; old Dhaka with its geopolitical position is still making intense influence over Bangladesh and the South Asian region indeed (Khatun, 2017).

### 3.6 Factory Location

The study was conducted in the chemical factories of Old Dhaka region of Dhaka South City Corporation. This area is very much congested and a well-established business hub in the heart of Dhaka city where several massive fire incidents have occurred in the recent past. That is why researcher chose this area for meeting the research objective.



Figure 1: Old Dhaka region of Dhaka

### 3.7 Data Collection Methods and Instruments

To explore the knowledge of fire safety management among chemical industry workers and authorities' quantitative data were collected through the survey method by using a structured questionnaire. For ensuring reliability and validity, a pilot study was conducted among fifteen

respondents, and minor modifications were adjusted accordingly. For qualitative data, key informants' interview (KII) and content analysis were done.

**Table 2: Data Collection Methods and Instruments**

Method	Instrument	Types of Data	Objective
Survey	Structured Questionnaire	Quantitative	To explore chemical factory workers and owners' knowledge on fire safety management in Bangladesh
KII, FGD	Guidelines	Qualitative	To identify the existing fire hazard management system in the chemical industries
Content Analysis	Secondary Sources	Qualitative	the challenges in implementing a proper fire safety management system in chemical industries and recommend solution for them.

### 3.8 Data Analysis Plan

Data processing involves looking through collected data and editing it for errors. Errors in data occur due to failing to record, wrong entry, ineligibility of words or numbers in recordings, jammed recording instruments, outliers, and miscalculations. Collected data were chronologically arranged with respect to the questionnaire outline to ensure that the correct code is entered for the correct variable cleaned and tabulated.

This study triangulated different methods in data collection. Triangulation of methods enabled the researcher to collect quantitative and qualitative data pertaining to the research questions. This research report is based on the primary data collected from the field. The primary data were collected from the field through survey questionnaires, in depth interview and key informant interview. For analyzing the collected quantitative data through a social survey, SPSS 24 version has been used and Atlas ti7 version has been used for analyzing collected qualitative data.

### 3.9 Measurement Scale:

In addition to demographic data, a questionnaire survey with sixteen questions about fire safety management was conducted to assess workers' and authorities' knowledge of fire safety management in the chemical industry. Respondents were asked to answer ten yes-or-no questions about their attitudes toward fire safety and prevention, as well as to assess their



understanding of the fire triangle, fire safety, risk, and control six open-ended questions were used. According to the number of correct answers, the knowledge score has been determined. For every right answer, there was one point, and no point was allocated or deducted for the wrong answer, to reach a maximum of sixteen points.

### **3.10 Ethical Consideration**

For ensuring the ethical issues, written and/or oral consent has been collected from every individual in the study. They were confirmed the security of their information and were informed that information provided them will not be disclosed anywhere except to this study purpose.

The Survey for the work “**Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in Old Town Dhaka**” has been conducted on selected establishments those manage works with chemicals.

4.1 Demographic information

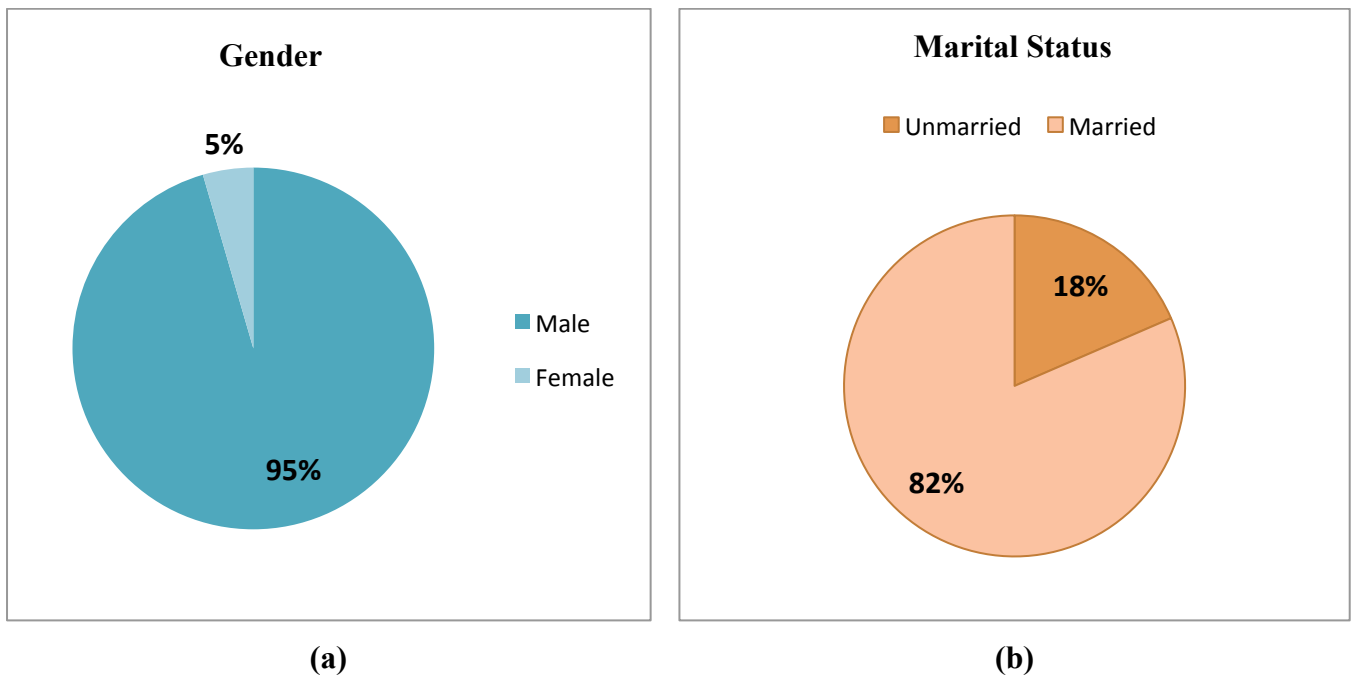
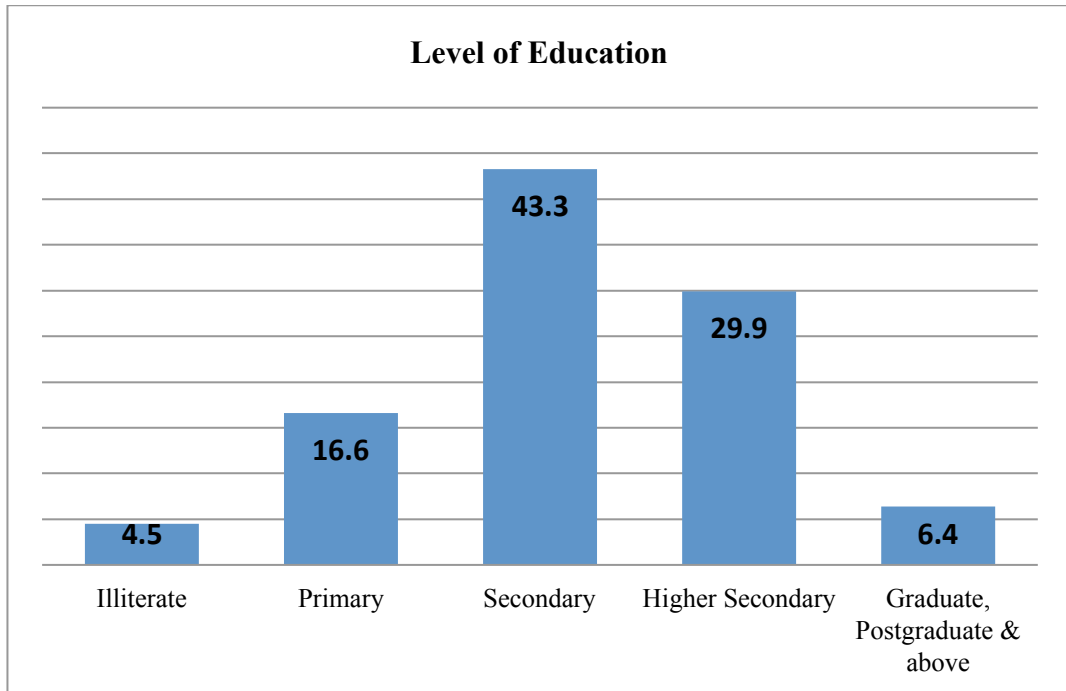


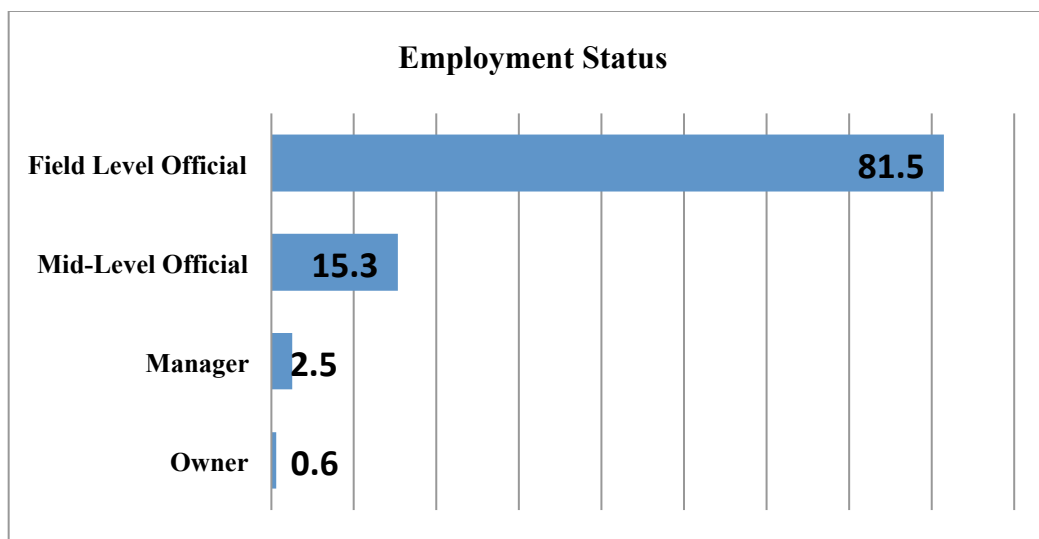
Figure 2: (a) Gender ratio (b) Marital status of workers

The above figure (2) showed the gender ratio and marital status of the worker’s chemical industry. 95.5% of male responders were recorded while conducting the work. A little 4.5% woman was found in the study that comparatively little amount to the male. Moreover, most of the workers (82%) of the chemical industry were unmarried and rests of the workers are married (18%).



**Figure 3: Level of education of the workers**

The above figure (3) showed about the level of education of the of the participants. About 70% of the participants are from secondary and higher secondary level. Only 4.5% of them are illiterate and 6.4% of the participants completed the graduation level.



**Figure 4: Employment status of the participants**

The above figure (4) mentioned about the occupational status of the participants. Most of the

participants (81%) are from the field level officials and rests of the participants are from the mid-level officials, managers and owner.

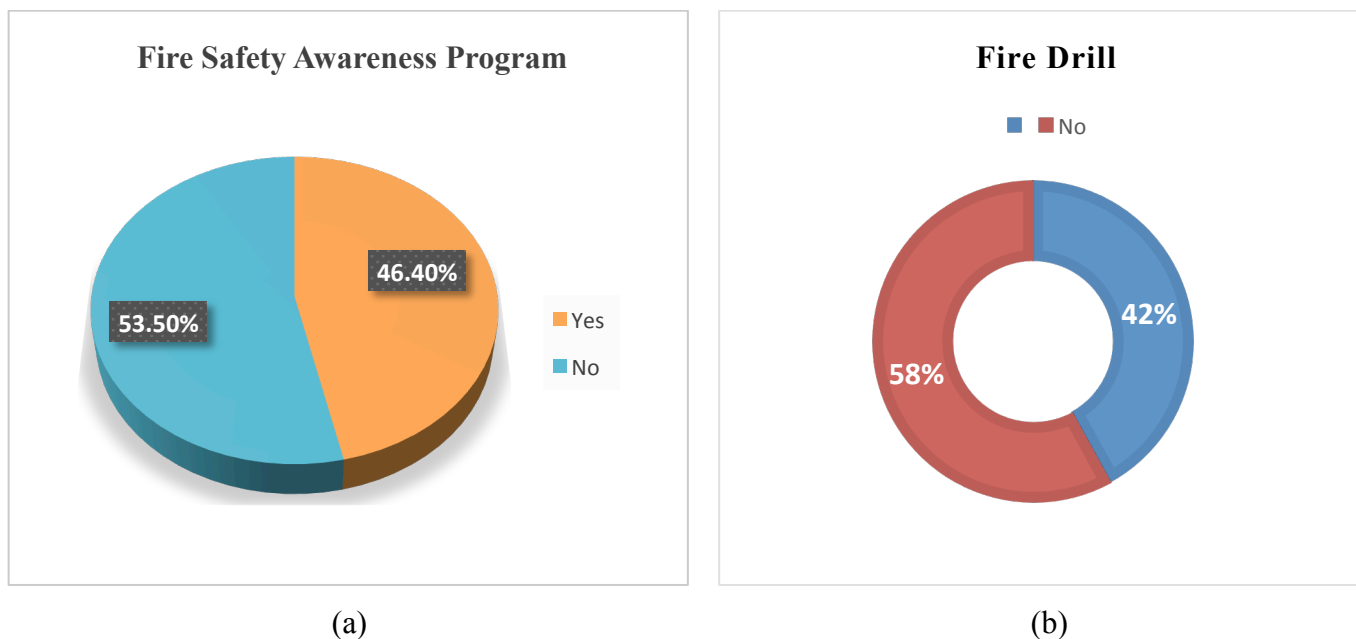
**Table 3: Demographic Information of Respondents**

<b>Descriptive</b>	<b>Mean</b>	<b>Standard Deviation</b>
<b>Age</b>	34.34	9.437
<b>Monthly Expenditure (Individual)</b>	8082.80	4193.93
<b>Daily working hour/day</b>	9.52	2.263

On average the workers at these chemical industries come with 11.85 years of experience; traces of freshers at work are found as well. Out of the survey, result shows- the minimum age of the responders was sixteen reflecting the presence of child labor inside. The contemporary legal system of Bangladesh finds which entirely illegal indeed. The minimum expenditure of the responders was one thousand with an 81.5% married marital status was found. On average the monthly income is found poor with the individual monthly expenditure comparatively.

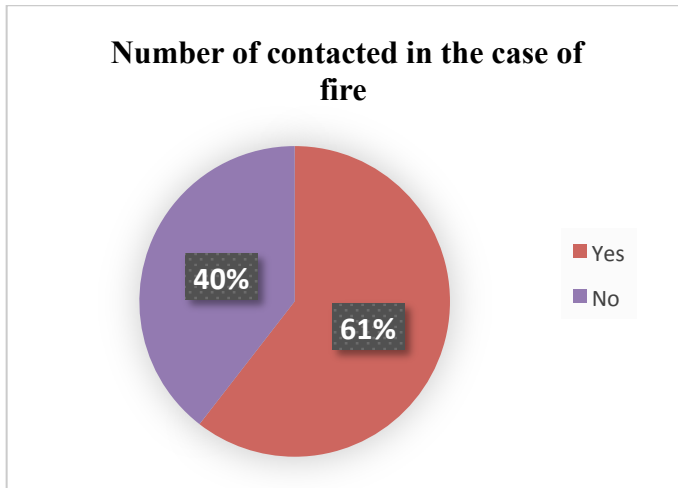
Poor income capacity makes those dependent families bound to serve knowing life risks at workplace. On average workers makes  $9.52 \pm 2.263$  hours per day (Table 3) at the industries, whereas the existing “labor law of Bangladesh” prescribes the maximum working hours after 8 hours per day. Thus, combinedly with poor income opportunities, living conditions enforces the labor to work at these chemical industries knowing or unknowingly that their rights of labor at work is being violated here, but they are left with no options behind at all.

#### 4.2 Level of knowledge of chemical industry workers and authorities on fire safety management.

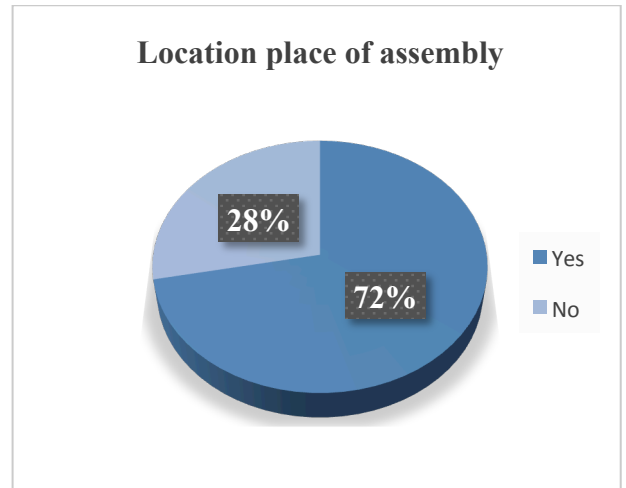


**Figure 5: Participants participate in (a) Fire safety awareness program and (b) Fire drill**

The figure (5) explained the percentage of participants participated in fire safety awareness program and fire drill. About 46.40% participants attended the Fire and rescue department organized fire safety awareness programs and 53.50% participants did not attend the program (figure 5a). Figure 5 (b) shows that out of the total respondents 58% did not participate at fire drill programs, which reflects that there is a signification quantity of non-participators exists. But, fewer 42% of the participants attend the program that means of better awareness and level of safety knowledge available at practice indeed.



(a)

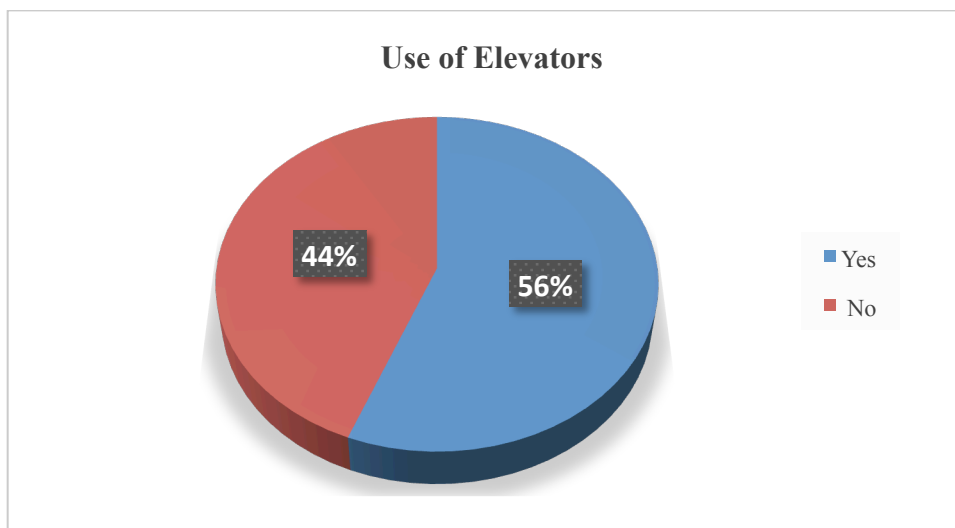


(b)

**Figure 6:(a) Number of contacted in the case of fire and (b) Location place of assembly**

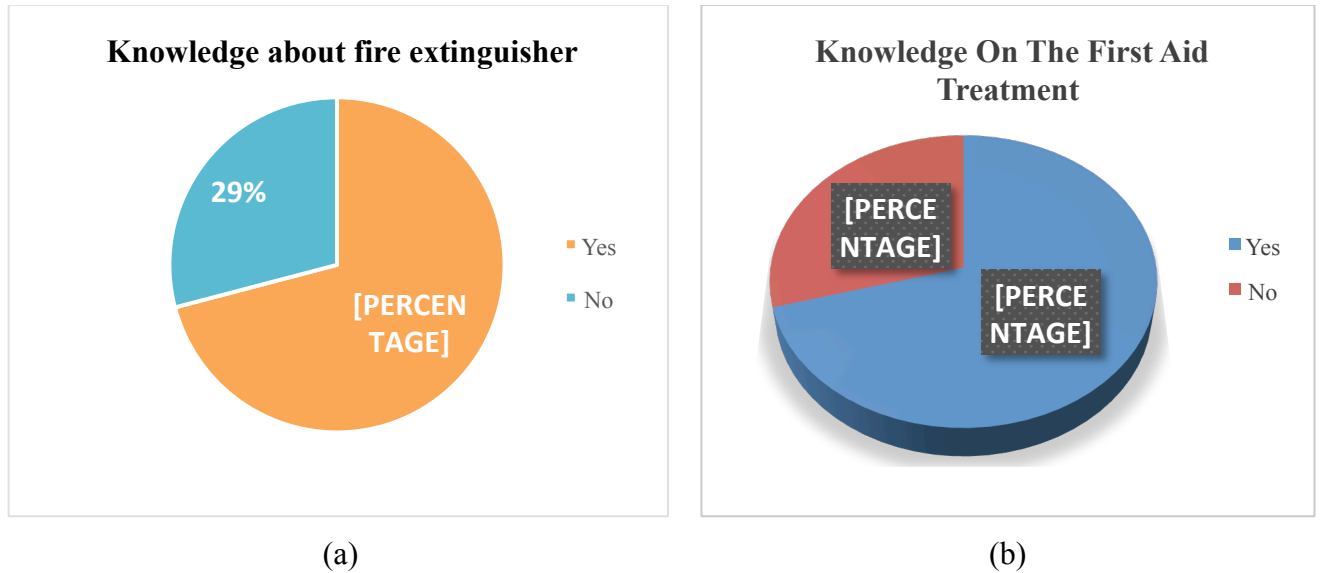
The above figure 6(a) showed that 60.5% of the study respondents have knowledge about the emergency contact number for fire assistances in cases of emergency. However, 39.5% covering more than one-third still in the vogue.

The figure 6(b) represented that 71.9% respondent responded positively when they were asked whether they knew about the location place of assembly of the building during fire. However, almost one third of the respondents (28.1%) found not familiar with such knowledge at all. in cases of fire.



**Figure 7: Use of Elevators**

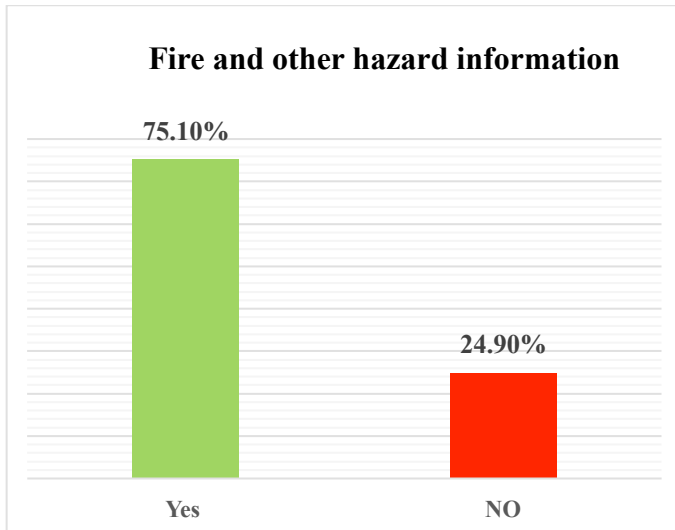
The above figure 7 showed that 56% of the respondents were aware of the knowledge that elevators should be avoided during fire. Whereas half of the total 44% of the respondents were completely unaware about the question.



**Figure 8: (a) Knowledge about fire extinguisher and (b) first aid treatments**

The above figure 8(a) presented that 70.3% of the respondents knew about operating fire extinguisher which is significant. Yet, another 29.7% responded their incompetence- mostly due to either negligence or lack of coordination.

The figure 8(b) also represented that 70.7% of the responses recorded after, they have the knowledge on the first aid treatment of a fire burnt individual. Whereas 29.3% of the participants reflected that they have lack of knowledge on the first aid matters.



(a)

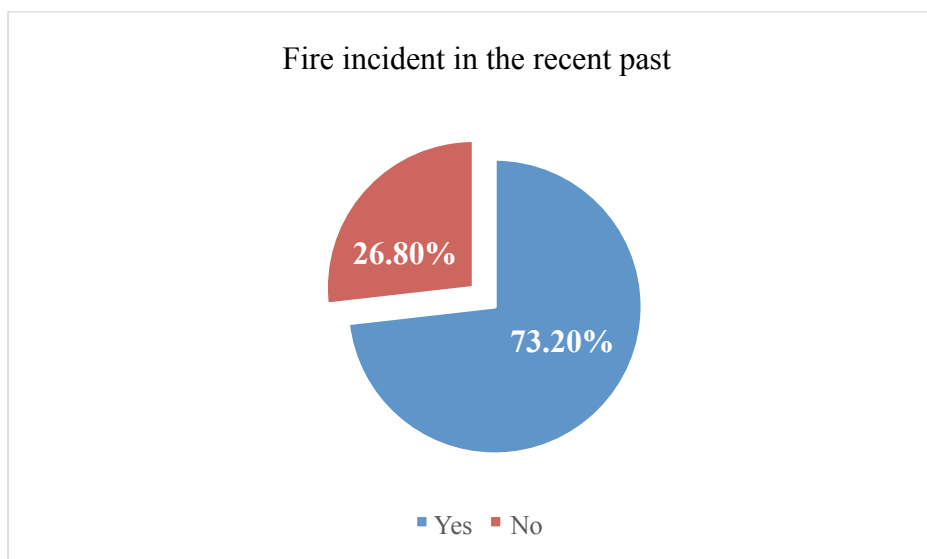


(b)

**Figure 9: (a) Fire and other hazard information (b) Fire safety management plan**

The above figure 9(a) presented that 75.1% respondents knew about the fire and other hazard information about the chemicals they produce or store in the factory. Another 24.9% almost a quarter of total response marked their lacks in identifying chemicals and related information.

The figure 9(b) pointed out that 67.5% responded answered their industry have distinct safety management plan. Another 32.5% responded answered that there has no distinguish plan.



**Figure 10: Fire incident in the recent past**



The above figure (10) presented that 73.2% have witnessed fire incident either at own or adjacent industries. Whereas 26.8% mostly the workers with comparatively less experience responded that they have not witnessed any till date of data collection.

**Table 4:Level of knowledge of chemical industry workers and authorities on fire safety management.**

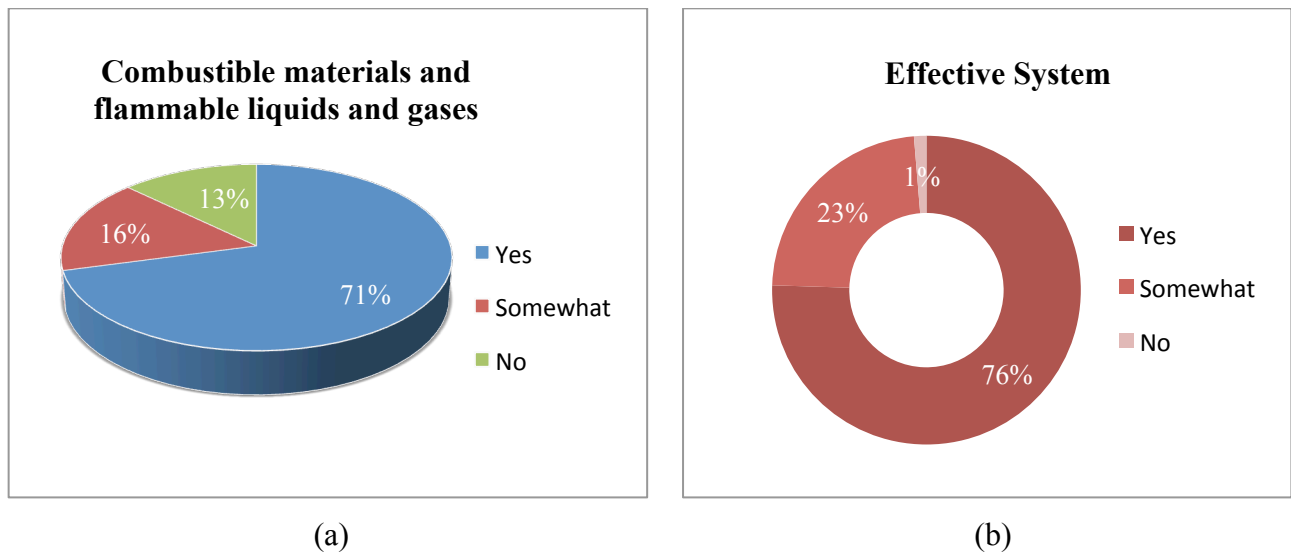
Question	Responses
Who is the emergency contact of the person in charge in case of fire emergency?	87.3% of the responders came with the knowing about the person to be contacted in case of fire emergency and 12.7% are still not familiar with this position
Please describe procedures that must do when fire Occur?	78.7% responders demonstrated positively during the survey study. They positioned their knowledge about procedures to maintain and make during fire accidents. Only a 21.3% failed in doing so, who are newly inducted to the industry themselves.
Where is the emergency exit route in this industry? Please describe	72.9% knew, the path to exit, whereas 26.1% respondents were not introduced with the routes- keeping them unaware. This might occur for the respondents' negligence on the issue as well.
How do you tend to give immediate response to the Alarm Signals in the Event of Fire, please describe?	60.4% responded positively and showed their competencies; accordingly, another 39.8% failed in doing such though.
What do you think is the fastest way to evacuate occupants during a fire incident?	Eighty-three percent responded that fire exit doors are the most convenient ones. and another 17% opted for fire escape staircase for emergency evacuation.
How will you react if your industry faces any fire incident? Please tell us a brief about it	75.2% of responses seemed that, they knew what to do and what not. However, in 24.8% responses- absence of knowledge and preparedness was found acutely.

The result of the above table shows 87.7% participants demonstrated positively during the survey study. They positioned their knowledge about procedures to maintain and make during fire accidents. Only a 21.3% failed in doing so, who are newly inducted to the industry by themselves. But the number of the participants who did not know the procedures of fire safety management in emergency case is not so less.

72.9% of the total respondents knew, the path to exit and it is hopeful that maximum of the participants is aware of emergency route. This table represents the percentage covering the demonstration asked before the respondents about their immediate response to alarm the signals in cases of fire. 60.4% responded positively and showed their competencies; accordingly, another 39.6% failed in doing such though. Yet, based on the most quantity; the context can be label as found positive in chemical industries at practice.

However, 75.1% respondents knew about the fire and other hazard information about the chemicals they produce or store in the factory.

#### 4.3 Evaluation of the existing fire hazard management system in the chemical industries

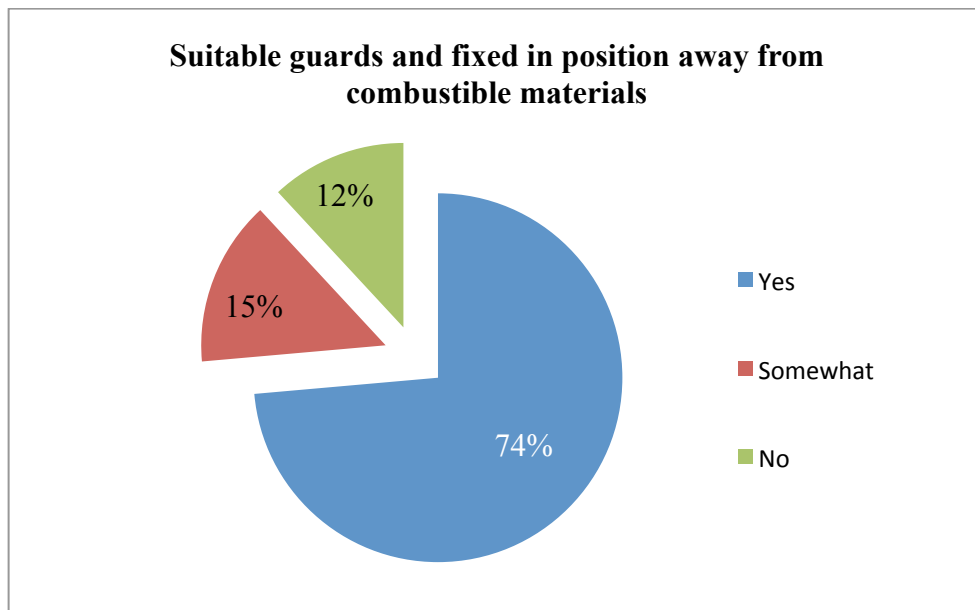


**Figure 11: (a) Response of workers at combustible materials, flammable liquids, and gases-controlling system and (b) Effectiveness of present system**

This above figure 11(a) represents the response of workers at chemical industries about the

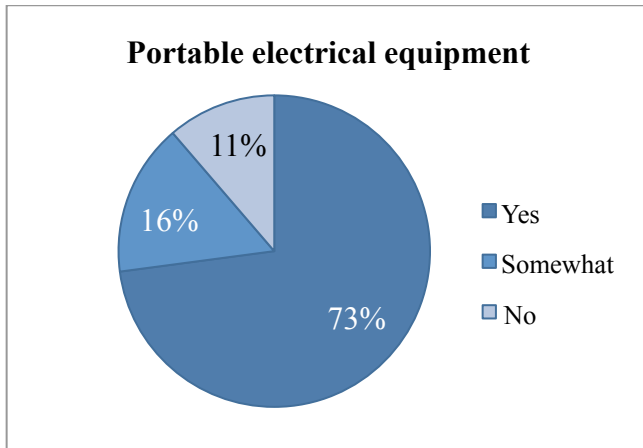
availability of combustible materials, flammable liquids, and gases- controlling system. 70.8% of the participants responded positively, on the other hand 16.4% were not sure about the availability, whereas- 12.8% confirmed absence of any control system at all.

The figure 11(b) portrays the results- whether the present system is operating effectively or not. Out of the Responses, 75.5% were marked positively. 32.2% of the respondents were not sure about the system's operation. 1.3% responded that, the chemical controlling system not working effectively at all.

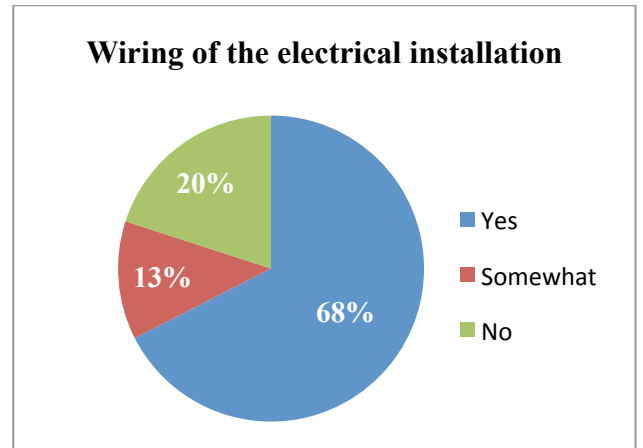


**Figure 12: Suitable guards and fixed in position away from combustible materials**

The above figure 12 indicated that 73.6% of the respondents marked that, the heaters were fitted accordingly and fixed away from combustible materials to avoid any unwanted scenario. Though another 14.5% responses were not sure about the position of heaters and on. 11.9% of the responses were found risky entirely.



(a)



(b)

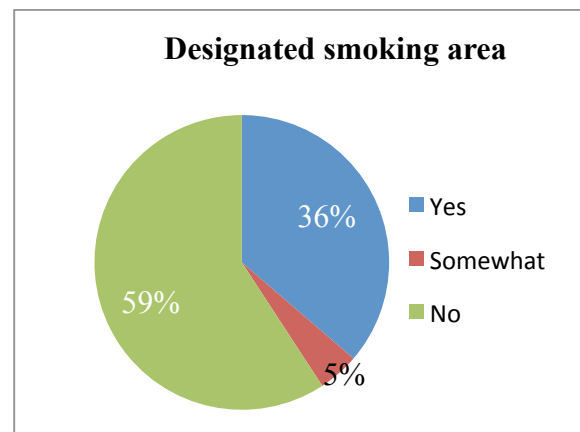
**Figure 13:(a) Portable electrical equipment and (b)wiring of the electrical installation**

The above figure 13(a) mentioned that 72.9% respondents reported that, the portable electrical equipment was inspected regularly and fitted with correctly rated fuses. Whereas 11.3% of the respondents marked that there is an acute absence of regular equipment inspection and concerns about correctly rated fuses.

The figure 13(b) mentioned that 12.5% of the respondents answered positively that needs more serious attention indeed. And 20% of the respondents denied it. They reported that the wiring of the electrical installations was not inspected at all periodically by any competent person-technician.



(a)

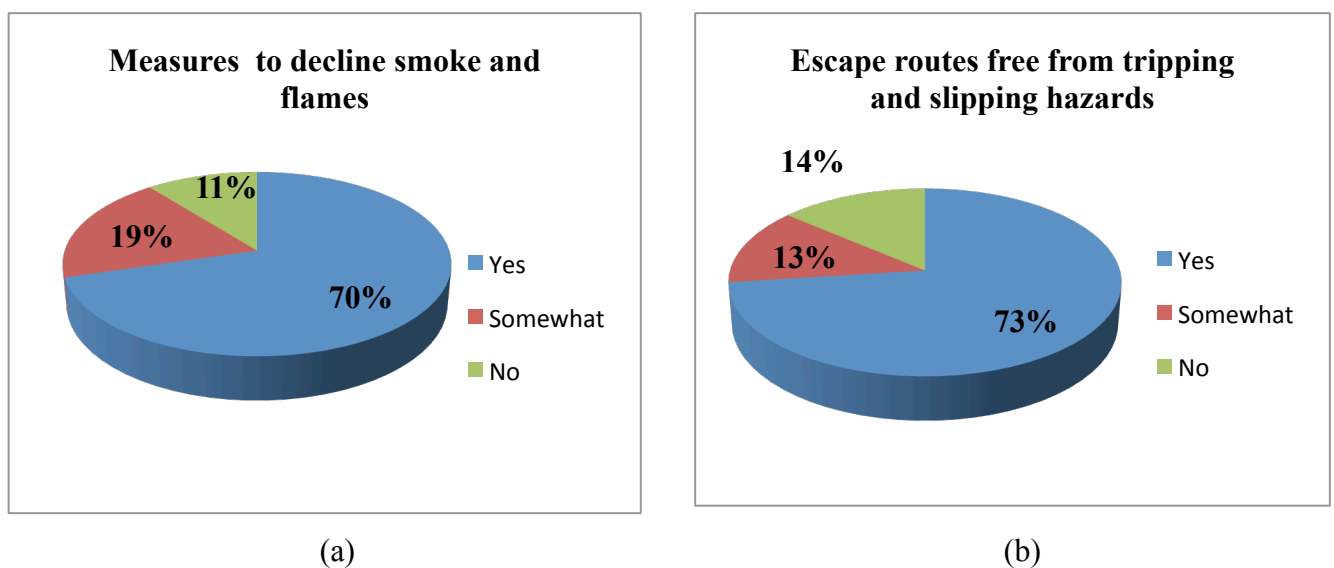


(b)

**Figure 14: (a) Free of rubbish and combustible waste materials and (b) Designated smoking area**

The above figure 14(a) reported that 73.6% responses the workplace remaining free of rubbish and combustible waste materials. Responders also pointed that- in 23.2% responses the workplace is moderately free from waste materials. 3.2% positioned their notion about their workplace as to not be free of rubbish and combustible waste materials at all.

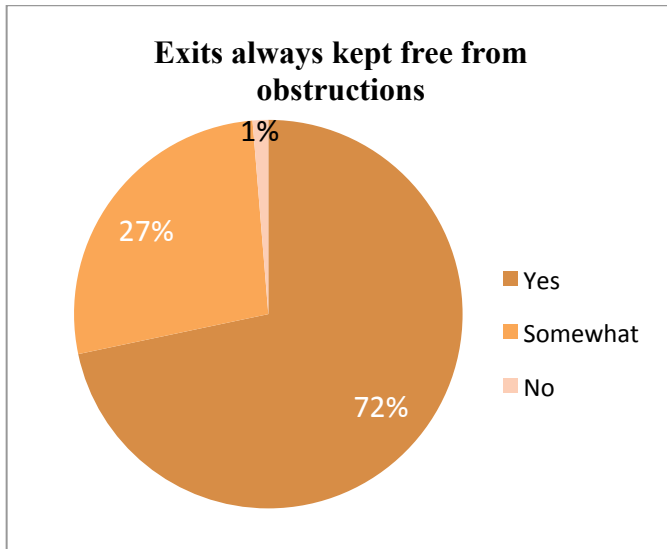
The figure 14(b) explained that 36.3% respondents marked that they have a designated smoking area provided with adequate ashtrays in their workstations. 4.5% respondents marked that such facility is present only making a moderate effect. But, in 59.2% responses, at major portion of industries lacked in dedicated smoking area in the industry at all.



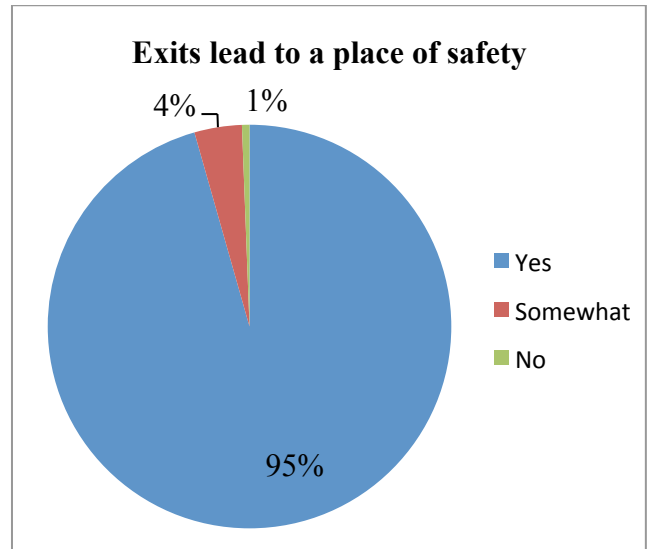
**Figure: 15(a) Measures to decline smoke and flames (b) Exits always kept free from obstructions**

The above figure 15 (a) pointed that 71.1% respondents supported the significant measures have been taken to ensure that smoke and flames cannot spread from one compartment within the building to another. 19.1% responders marked that they are not completely sure about it. Measures might be taken of a moderating effect. However, 10.8% respondents support absence of such measures.

Figure 15(b) represented that 73% of the respondents reported that the escape routes were free from tripping and slipping hazards. A portion of 13.2% marked that these exists are free from such unexpected. Amidst, another 13.8% directed that, these exits are not free from such tripping and slipping hazards at all.



(a)

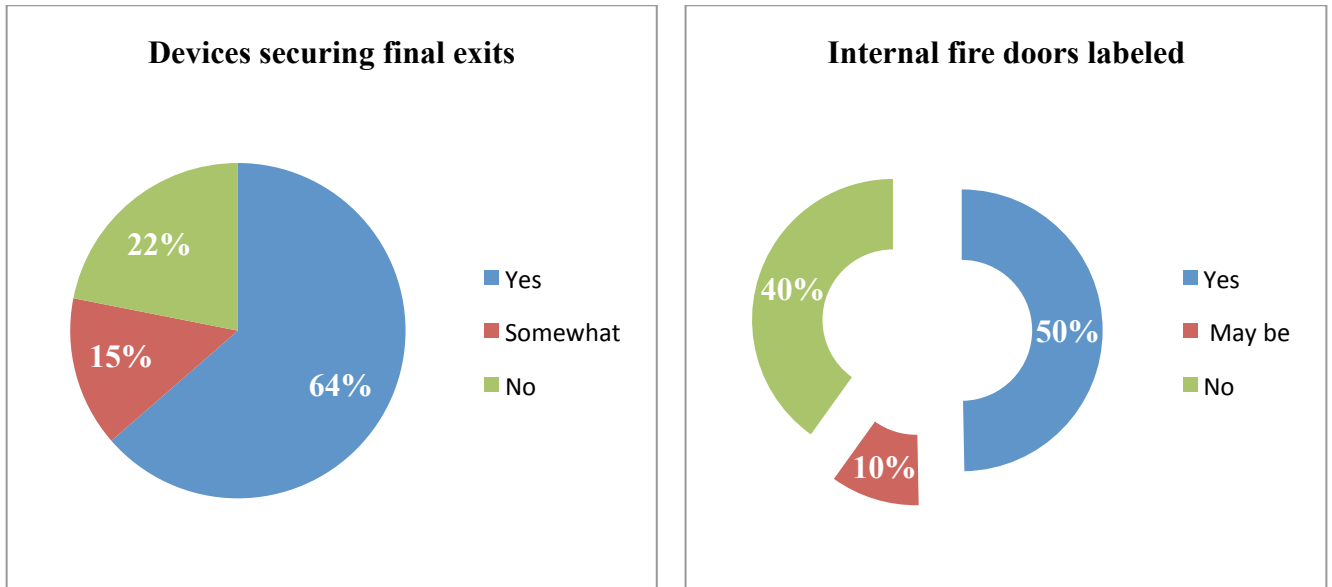


(b)

**Figure 16: (a) Exits always kept free from obstruction (b) Exits lead to a place of safety**

Figure 16(a) explained that 71.7% participants responded affirmatively. 27% of the responses received as responders found those exits free, but 1.3% completely denied the statement based on own experience.

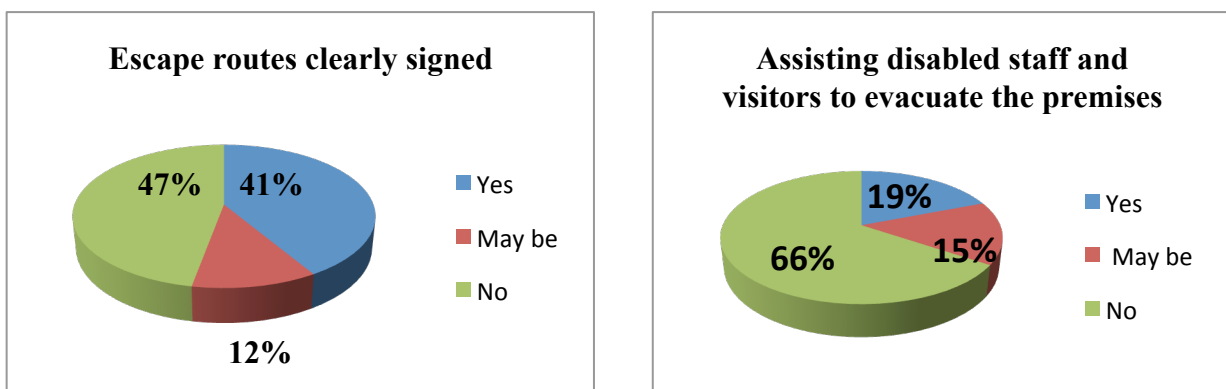
Moreover, figure 16(b) pointed that 95.5% of the respondents expressed that their concerned exits lead to a place of safety as mentioned in the table. 3.8% were not sure where the exits lead. Whereas 0.6% responses counted after the position of exits not leading to any place of safety.



(a) (b)  
**Figure 17: (a) Devices securing final exits and (b) Internal fire doors labeled**

The above figure 17(a) presented that 63.6% of the respondents have full confidence over the competence of those security devices. Whereas 14.5% respondents were found moderately satisfied by the study questions and another 21.9% were not confident at all.

The figure 17(b) presented that 50% of the respondents responded that the internal fire doors are labeled and normally kept closed. 10.2% responses of moderate result been recorded with another 40.1% responses they respond as- the internal fire doors are not kept closed normally at all.



(a) (b)  
**Figure 18: Escape routes clearly signed and (b) Assisting disabled staff and visitors to evacuate the premises**

The above figure 18(a) figured that 41.4% of the respondents expressed that escape routes are signed properly. Whereas- 47.1% respondents expressed that the route not signed at all. Amidst another block emerges with 11.5% which directs that, the escape route is signed only.

The figure 18(b) portrayed both frequencies of response and percentage. With a major portion of 65.6% responded negative that no such efforts are being made. Some 19.1% agrees of making such practices; however- another 15.3% says that issues concerning such contexts are rehearsed only.

#### **4.4 Challenges in implementing a proper fire safety management system in chemical industries**

Bangladesh is a densely populated country and the population issue in Old Dhaka is beyond compare. This huge density of population causes serious issues in fire safety management of Old Dhaka chemical factories and for the general residents as well. Though the factory owners have strongly asserted that they have arranged all the necessary arrangement for the fire fight and risk reduction but those are not enough to tackle the fire incidence in Old Dhaka. In this regard, one of the chemical factory owners added that,



**Figure 19: Image-1**



*“We have our inbuilt water supply facilities, fire extinguisher, sand bucket for any emergency in our factory. We trained our employees in fire safety management from the local fire brigade office and check-up our machineries every day before starting our work. Dangerous chemicals are stored separately in a single room where only a few selected employees could enter and collect chemicals from there. The local fire fighters’ number is circulated to every employee of our company, and they know what need to be done in the emergency.” (KII 10, Personal Communication, January 10, 2022).*

But when the factory owners are asked that you people are quite cautious about fire incidents but still why Old Dhaka is so vulnerable to fire incidence in recent times. Then they gave the charge totally to the Urban Development department of the Government. This authority has working with no such comprehensive plan to develop the safe cities with sufficient precautionary measures and instruments. In this context, another chemical factory owner reported that,



**Figure 20: Image-2**

*“Though we all both owners and workers are completely aware of fire safety management, it is causes, effects and preventive measures, the urban development*

*department and RAJUK authority have many limitations to maintain city safety. They have lacking's of maintaining building code, structured city development plans. All the buildings of old Dhaka are congested, the roads are to narrow, the gas lines and electric transformers, wires etc. all are unplanned. That is why after being conscious of fire safety and incidence we are unable stop continuous fire accident in Old Dhaka.” (KII 12, Personal Communication, January 11, 2022).*

All the fire incidence in this area were occurred from the electric short service or transformer blast or explosive chemicals and the fire accidents got worsen because of inadequate emergency exit, ignorance of the workers, storage of combustibile chemicals without get knowing the workers of the factories. When the workers of different factories are asked as you are fully aware of your life safety, fire accidents, still why the fire accidents are occurring in this area. In these circumstances, the workers of chemical factory asserted that,



**Figure 21: Image-3**

*“We are the workers, and the owner of our chemical only instructs to get work properly. They have no concern about our lives and fire safety management. In the factories, there are raw materials in everywhere, but we have no fire safety instruments like fire extinguisher, no nearby water reservoir. We all are untrained*

*for fire safety. The factory authority barely trained us. Even we do not know about the storage of combustible and explosive chemicals, and it left us a great danger. All the factories are congested, and the emergency exits are too narrow to go out during emergency.” (FGD 2, Group Communication, January 13, 2022).*

The continuity of fire incidence is increasing, and its consequences are worsening day after day when the fire brigade of BFSCD are informed about the fire accident, exactly right then If they reach out there, the consequences of fire accidents might be slowed down. But most of the cities of Bangladesh are rarely planned and the worst case is seen in Old Dhaka. The roads are very narrow there, the whole way to go the spot is highly congested by transports and people. When a fire brigade officer is inquired why did fire accidents occurred and why couldn't be slowed down the consequences? In this question he reported that,

*“When we are informed about the fire accidents, we promptly went out for help. But we all know the existing road situations and the scenario of the Old Dhaka. All the roads are narrow and blocked due to over traffic. We tried to reach out the spot by heart, but the situation could not allow us. That is why we could not minimize the losses of property and lives. Moreover, the aversion of workers and mostly aversion for the owners of the chemical factories are responsible for the causes and consequences of fire accidents.” (KII 13, Personal Communication, January 15, 2022).*

To minimize the fire incidence and losses of property and lives in the chemical factories area in Old Dhaka the raising awareness among workers and owners, proper policies of the government, government subsidies, implementing the building code of the RAJUK is imperative. In this regard one of the fire workers said,



**Figure 22: Image-4**

*“Wherever the fire accidents took place, I saw one common thing that is the unplanned building design. All the buildings are congested in Old Dhaka. And outside the old Dhaka the building codes are not implemented properly. I think to minimize the losses and incidence of fire the government should make better plan, building codes, lower the price of fire extinguishing instruments and upgrade the fire safety management department.” (KII 14, Personal Communication, January 13, 2022).*





**Figure 23: Image 5**

A chemical factory owner reported that,

*“We are being more cautious against fire accidents than before. But we have experienced the lack of instruments of BFSCD. The government should upgrade the fire safety department in line with the modern world to tackle the fire accidents in this area.” (KII 15, Personal Communication, January 14, 2022).*

All the respondents emphasize on the government support and tax-free fire equipment import in Bangladesh. If the price of those firefighting materials is within the reach of the owner and government policies and strict monitoring by the government officials are ensured, then the fire safety management system is bound to be developed within the brief period. Weak monitoring from the government offices and corruption practice of the industry owner are the main hindrance in transforming our chemical industry into compatible with fire incident.

## Chapter Five

### Discussion

The chemical industry in Bangladesh is performing poorly in last few decades and it's reliant on the import. The chemical handling in the big industries complying the international guidelines but the local industries are not complying most of the standard procedures in chemical storage and chemical handling in Bangladesh and that is why we witness devastating fire incidents in these chemical industries in last decade which cost a huge financial and workforce loss. Fire protection entails preventing an already-started fire from spreading from one place to other. There are two types of protection: passive and active.

Passive fire protection building a structure that itself is fire resistant, whereas active fire protection requires intervention by government and chemical forces. For any household or industry, passive protection is more pragmatic. The quest to explore the knowledge of the workers and authorities on fire management ended up with the summery that they possess information on fire management as it became a significant issue in Bangladesh and many of them knew how to fight with fire in the time of danger in a factory setting. The contribution of BFSCD is well recognized by them.

They all mention this force as a disciplined and well-organized force which has a capacity issue in firefighting situation. But the issues grow more alarming as most of the factories did not follow the building code and not intelligently designed to combat any kind of disaster. The major fault in the city planning specially in the Old Dhaka area made the situation worse for the residents and the factory owners. Government has warned the industries many times so that they could shift their factory in the Savar area where Government gives them industrial plot with all the amenities but due to lack of incentives they refuse to move and stay in the same place.

The National Building Code of Bangladesh 2018 states that an industrial building should follow two vending requirements- smoke & fire vending and explosion vending. Here a detailed structure is described how an industry should be and what measures they should take to take precautionary measures to reduce fire incidence. But a little is followed in the reality on the chemical industries in Bangladesh.

But in recent times after governments strong monitoring system and they are shifting gradually. Though they possess a little bit knowledge on the fire hazard management, but the factory compliance is below to the mark with the guideline of the fire standard. They fire materials are not adequate in those factories and chemicals are often remain open after use.

The situation become worse, as the roads are narrow, electricity lines are open, no source of water near those factories and the emergency exits are not enough for quick evacuating of the workers in the time of danger. The awareness level of workers working there are quite good as government and other partner organizations are working on the awareness building program on fire hazard management but due to lack of incentives from the government high price of fire safety materials, monetary loss during COVID 19, weak monitoring of the government agencies our chemical industries are in great danger in Old Dhaka.

As it is a commercially key area of the capital, quick initiatives should be taken to reorganize the Old Dhaka area. Otherwise, this business hub can be in great danger soon. A smart demarcation of the business and residential area in the Old Dhaka town has now become a crying need for the area. A strong political leadership and government's business friendly policies can ensure modernization of the Old Dhaka area within a quick period.

#### 6.1 Conclusion

The overall knowledge of the employees and concerned authorities about fire safety management is quite significant more than past. On average more than half of the workers are aware of fire safety management. Most of the workers of the chemical industries have certain level of knowledge about the fire safety to prevent the unbearable losses from the fire incidence. And the authority of the industries is aware of the worker's safety.

Employees those are surveyed have knowledge about the emergency contact number for fire assistances in cases of emergency, have the information and knowledge about the person to be contacted in case of fire emergency, their knowledge about procedures to maintain and make during fire accidents. Majority of the respondents knew, the path to exit and it is hopeful that maximum of the participants is aware of emergency route, they have the knowledge about the location place of assembly of the building during fire, have knowledge about the operational fire extinguisher procedures which is significant.

Besides, respondents knew about the fire and other hazard information about the chemicals they produce or store in the factory that means most of the workers and staffs of these chemical industries more cautious about the combustible and explosive chemicals that causes serious fire accidents. And on average more than half of the participants of the chemical industries workers agreed upon that their industries' authority provide sufficient instruments and compliances that can reduce fire incidence and prevent the potential losses of lives and properties. The owners of the chemical industries provide inbuilt water supply facilities, fire extinguisher, sand-bucket for any emergency case. They trained their employees in fire safety management from the local fire brigade office and got checked-up the machineries every day before starting work.

But due to the shortage of education of workers and the aversion of the owners in some cases make the fire safety management little vulnerable- A bulk number of respondents of the chemical industries who have hardly or No knowledge on chemicals at all. Proper knowledge of chemical



treatment and Storages, leads catastrophes in these chemical industries during fire accidents undoubtedly. Only a little portion of workers been found who passed the Higher Secondary, graduate, postgraduate and above degrees.

The authority of the chemical industries also failed to maintain the fire safety management training session effectively. More than half of participants did not attend at the Fire and rescue department organized fire safety awareness and fire safety programs. Apart from the fire accidents do not slow down because of the owners of the factories did not maintain the building codes developed by RAJUK. And the losses of lives and properties due to the fire accidents in Old Dhaka area could not be minimized because of the congested buildings position, narrow roads and too much blockage of transports that is why the fire brigade workers could not reach in time.

## **6.2 Recommendations**

Bangladesh is a densely populated country and the population issue in Old Dhaka is beyond compare. This huge density of population causes serious issues in fire safety management of Old Dhaka chemical factories and for the general residents as well. As the fire incidence in the Chemical factories and other factories caused unbearable losses of lives and properties every year in Bangladesh especially in Old Dhaka, the government and concerned authority should make better plan to prevent and minimize the losses.

- The owners of the chemical factories should arrange a comprehensive training on the fire safety management so the workers of these factories can tackle the initial problems and pacify the intensity of fire incidence.
- The owners or the authority of the chemical factories should let know the workers about the explosive and combustible chemicals that causes intensity of fire, where they are kept and show the caution marks in the store door where these are kept. For this the workers of these factories remain aware of these and keep distance from these storages while they smoke.
- The owners of the chemical and other factories should ensure the sufficient emergency

ghat and broad staircase for emergency exit and make the workplace free from fire incidence to follow the RAJUK buildings code

- The government should subsidize on the fire distinguishing instruments so that every building owner can be able to buy them and use them when they are in need.
- Before licensing the factories owners, the government and concerned authority should monitor the factories whether they are built in accordance with government building code or not.
- The government should upgrade the BFSCD department in line with the modern world to tackle the fire accidents in this area.
- Inspection and fire drill protocols should be devised and implemented on a regular basis by medium and large firms, and management should request regular inspection reports from the persons and departments concerned to assure organizational compliance
- A licensing system that permits authorized fire safety and prevention engineers or firms to execute fire inspections of buildings, investigations, and surveys, establish and review fire safety and evacuation plans, and other vital responsibilities can be adopted.
- Introducing both full-time and reservist fire fighters to reduce the number of full-time employees required, as well as cross-training and multiple service provision to allow the same emergency services personnel, equipment, and stations to serve multiple purposes, all of which help to spread out the costs of providing emergency services.
- The government may offer affordable and high-quality fire safety to its population by leveraging the resources and economic motives of the chemical sector. Either through a contract or a subscription, the chemical sector can offer fire protection services. Companies, residents, and property owners can go for subscription, while local governments or special fire areas can contract for the services.

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**Annex**

<b>ID</b>			
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**Date**

**Time**

**QUESTIONNAIRE**

All questions contained in this questionnaire are strictly confidential  
and will be used for the research purpose only

<b>SL</b>	<b>Questions</b>	<b>Answers</b>
1	Name of the Chemical Factory	
2	Address of the Chemical Factory	

<p>_____</p> <p><b>Field Supervisor's Signature</b></p> <p><b>Field Supervisor's ID:</b></p>	<p>_____</p> <p><b>Data Enumerator's Signature</b></p> <p><b>Data Enumerator's ID:</b></p>
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## CONSENT LETTER

Greetings!

My name is (interviewer's name) .....

I am a current student of Postgraduate Program in Disaster Management, BRAC university. I participate in research entitled **“Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in DSCC,”** which is conducted with technical support and financial support from BRAC university.

The purpose of the study is to explore the knowledge of fire safety management among chemical industry workers and authorities, evaluate the existing fire hazard management system in the chemical industries and investigate the challenges in implementing a proper fire safety management system in chemical industries and recommend workable solutions for them.

I assure you that the information you provide will be kept confidential and will not be disclosed to anyone. It will only be used for research purposes. Your name, address, and other personal information will be removed from the questionnaire, and only a code will be used to connect your name and your answers without identifying you.

Survey team may contact you again if it is necessary to complete the information on the survey. Your participation is voluntary, and you can withdraw from the survey after having agreed to participate. You are free to refuse to answer any question in the questionnaire. If you have any questions about this survey, you may ask me or contact the Principal Investigator of the study.

<b>Name of the Participant</b>	<b>Signature</b>
<b>Name of the Data Enumerator</b>	<b>Signature</b>

## Survey Questionnaire

### Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in DSCC

(All information collected in this study has been used for the study only and the anonymity will be strictly maintained)

#### Section A: Socio-Demographic information of the Respondents

Question	Responses
A1. Age	
A2. Gender	1. Male 2. Female
A3. Level of education	1. Illiterate 2. Primary school 3. Secondary school 4. Higher Secondary 5. Graduate, Postgraduate, and above
A4. Marital status	1. Unmarried 2. Married 3. Others
A5. Employment status	1. Owner 2. Manager 3. Mid-level officials 4. Field level officials
A6. Monthly Expenditure (individual)	
A7. Monthly Family income	
A8. Years of experience in chemical industries (years)	
A9. Daily working hour in the factory	

#### Section B: Level of knowledge of chemical industry workers and authorities on fire safety

management.

Question	Responses
B4. Do you Attend any Fire Safety Awareness Program Organized by Fire & Rescue Dept. or any Organizations?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B5. Have you been participating in a fire drill?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>3. No</li> </ol>
B1. Do you remember the number to be contacted in the case of fire?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B2. Who is the emergency contact of the person in charge in case of fire emergency?	
B3. Please describe procedures that must do when fire Occur?	
B6. Where is the emergency exit route in this industry? Please describe	
B7. How do you tend to give immediate response to the Alarm Signals in the Event of Fire, please describe?	
B8. Do you know the location place of assembly of this building during fire?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>

B9. Do you aware that the use of elevators during a fire should be avoided?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B10. What do you think is the fastest way to evacuate occupants during a fire incident?	<ol style="list-style-type: none"> <li>1. Fire exit doors</li> <li>2. Fire escape staircase</li> <li>3. Windows</li> <li>4. Elevators</li> <li>5. None of the above</li> </ol>
B11. Do you know how to operate a fire extinguisher?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B12. Do you know about the fire and other hazard information about the chemicals you produce or store in the factory?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B13. Do you have the knowledge on the first aid treatment of a fire burnt individual?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B14. Does your industry have a fire safety management plan?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B15. Have your own/adjacent industry have witnessed any fire incident in the recent past?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. No</li> </ol>
B16. How will you react if your industry faces any fire incident? Please tell us a brief about it	

**Section C: Evaluation of the existing fire hazard management system in the chemical industries**

Question	Responses
C1. Is there a system for controlling the amounts of combustible materials and flammable liquids and gases that are kept in the workplace?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. May be</li> <li>3. No</li> </ol>
C2. Is the system operating effectively?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
C3. Are all heaters fitted with suitable guards and fixed in position away from combustible materials?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
C4. Are all items of portable electrical equipment inspected regularly and fitted with correctly rated fuses?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
C5. Is the wiring of the electrical installation inspected periodically by a competent person?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
C6. Is the workplace free of rubbish and combustible waste materials?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
C7: Is there a designated smoking area provided with adequate ashtrays?	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>

<p>C8. Have any measures been taken to ensure that smoke and flames cannot spread from one compartment within the building to another?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
<p>C9. Are there enough exits of suitable width for the people present?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
<p>C10. Are those exits always kept free from obstructions?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
<p>C11. Do the exits lead to a place of safety?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
<p>C12. Are the escape routes free from tripping and slipping hazards?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. Somewhat</li> <li>3. No</li> </ol>
<p>C12. Are the devices securing final exits capable of being opened immediately and easily without the use of a key?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. May be</li> <li>3. No</li> </ol>
<p>C13. Are internal fire doors labeled as such and normally kept closed?</p>	<ol style="list-style-type: none"> <li>1. Yes</li> <li>2. May be</li> <li>3. No</li> </ol>

C14. Are escape routes clearly signed?	<ol style="list-style-type: none"><li>1. Yes</li><li>2. May be</li><li>3. No</li></ol>
C15. Have plans been made and rehearsed regarding assisting disabled staff and visitors to evacuate the premises?	<ol style="list-style-type: none"><li>1. Yes</li><li>2. Somewhat</li><li>3. No</li></ol>

**Thank you very much again for your cooperation with this research!**

## KII Guideline

### “Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in DSCC”

CS_01	Questionnaire ID		
CS_02	Interviewer ID – and (Name)		
CS_03	Interview location		
CS_04	Interview date and time	Day/Month/Year	Time (am/pm)
		...../...../.....	

#### V. Introduce yourself with the respondents

.....



## Informed Consent Letter

Greetings!

My name is (interviewer's name) .....

I am a current student of Postgraduate Programs in Disaster Management, BRAC university. I participate in research entitled **“Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in DSCC,”** which is conducted with technical support and financial support from BRAC university

The purpose of the study is to explore the knowledge of fire safety management among chemical industry workers and authorities, evaluate the existing fire hazard management system in the chemical industries and investigate the challenges in implementing a proper fire safety management system in chemical industries and recommend workable solutions for them.

I assure you that the information you provide will be kept confidential and will not be disclosed to anyone. It will only be used for research purposes. Your name, address, and other personal information will be removed from the questionnaire, and only a code will be used to connect your name and your answers without identifying you.

Survey team may contact you again if it is necessary to complete the information on the survey. Your participation is voluntary, and you can withdraw from the survey after having agreed to participate. You are free to refuse to answer any question in the questionnaire. If you have any questions about this survey, you may ask me or contact the Principal Investigator of the study.

<b>Name of the Participant</b>	<b>Signature</b>
<b>Name of the Interviewer</b>	<b>Signature</b>

**Section A: Respondent's socio demographic characteristics**

<b>SI No</b>	<b>Questions</b>	<b>Coding Categories</b>	<b>Code</b>
A1	Gender	0= Female 1= Male	
A2	What is your educational qualification?	1= Graduate 2= Postgraduate 3= PhD 4= Others [ <i>please specify:</i>	
A3	What is your current designation?	...	

**Section B: Challenges in implementing fire safety management system in chemical industries**

<b>SL No</b>	<b>Question</b>	<b>Comment</b>
B1	What are the challenges (policy and management) you are facing in tackling fire incidents in your	

	industry?	
B2	Why are our chemical industries so vulnerable to fire incidents? please elaborate	
B3	Describe your opinion on the frequent fire incidence in the DSCC area and chemical industries in recent times.	
B4	Is our BFSDA good enough to combat fire incidence in Bangladesh? Please elaborate	

**Section C: Solution to implement proper fire safety management system in chemical industries**

<b>SL No</b>	<b>Question</b>	<b>Comment</b>
C1	What could be the preferable solution to face this deathly incident in the chemical factories of	

	Bangladesh?	
C2	How can the Government and volunteer organizations work on fighting against fire incidents in Bangladesh?	
C3	Do you think that our existing policy is good enough to prevent fire incidents in Bangladesh?	
C4	What changes do you suggest in the fire management policy of the government to ensure sustainable business growth in Bangladesh?	

**Thank you very much again for your cooperation with this research!**

**FGD Guideline**

**“Role of Chemical Industry in Fire Safety Management in Bangladesh: A Case Study in DSCC”**

CS_01	Questionnaire ID		
CS_02	Interviewer ID – and (Name)		
CS_03	Interview location		
CS_04	Interview date and time	Day/Month/Year	Time (am/pm)
		...../...../.....	

**V. Introduce yourself with the respondents**

.....

1. Please share your experience of a fire incident you witnessed near your workplace?
2. If the factory is under fire, what will you do? Please describe
3. What type of materials are needed for what type of fire? Please describe
4. Where will you all assemble at the time of fire? Please describe

## Field Evidence



**Picture 1: The data collectors collect data from workers of Chemical Industry.**



**Picture-2: The machine of chemical industry.**



**Picture-3: Two persons collect survey data from chemical industry workers.**



**Picture-4: A person gathers information from industry worker.**



**Picture-5: Boiler Machine of Chemical industry.**



**Picture-6: A person collects information from tannery industry worker.**





**Picture-7: Two person observe the environment of tannery industry.**



**Picture-8: A person observes the environment of tannery industry.**



**Picture-9: A machine of Chemical Industry.**



**Picture-10: A person gathers information from workers of tannery industry.**



**Picture-11: Overall environment of tannery industry where data collectors collected data.**



**Picture-12: A group of people collect data from industry's workers.**



**Picture-13: A group of people collect survey data from workers.**



**Picture-14: A group of people collect survey data from workers.**



**Picture-15: Working environment of tannery industry.**



**Picture-16: A person collects data from chemical worker.**