"A STUDY ON THE IMPORTANCE OF HANDLING HAZARDOUS MATERIALS IN SUPPLY CHAIN MANAGEMENT"

PROJECT REPORT

Submitted to the school of Maritime Management, Indian Maritime University in partial fulfilment of the requirements for the award of degree;

"MASTER OF BUSINESS ADMINISTRATION"

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Submitted by

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DECLARATION

The project work titled "**A STUDY ON THE IMPORTANCE OF HANDLING HAZARDOUSMATERIALS IN SUPPLY CHAIN MANAGEMENT"** has been carried out under the direction of Dr. YOGAMALA H L. in partial fulfilment of the requirements for the award of degree ofMaster of Business Administration in Port and Shipping Management to be submitted to the School of Maritime Management, Indian Maritime University, Kochi Campus.

Date: 24/05/2022 AISWARYA K

Place: Kochi

CERTIFICATE

This is to certify that the report titled "**A STUDY ON THE IMPORTANCE OF HANDLING HAZARDOUS MATERIALSIN SUPPLY CHAIN MANAGEMENT"** submitted to the School of Maritime Management, Indian Maritime University, Kochi Campus, by **AISWARYA K** .(Registration Number: 2005305001) in partial fulfilment of the requirements for the award of degree of Master of Business Administration in Port and Shipping Management is a record of project work done under my supervision.

Date: 24/05/2022 Dr. YOGAMALA H L

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EXECUTIVE SUMMARY

Dangerous goods, shortly DG, are substances which pose risk to health, safety, property or the environment when transported. Some dangerous goods that pose risks are called hazardous materials (HAZMAT) even if they are not transported. At Global Hazmat, there are many businesses in numerous industries that deal with hazardous materials on a daily basis. The main aim of this study was to understand the role of safety measures taken while handling Hazardous material and on various procedures and case studies related to Hazardous material. Hazardous materials come under chemical regulations. Hazmat teams are specially trained staff to treat dangerous items, including radioactive, flammable, explosive, corrosive, oxidizing, asphyxiating, bio hazardous, poisonous, pathogenic or allergenic materials. Most of the Accidents happened in warehouses due to the non-compliance safety measures. The mitigation of hazardous material risks can include the application of safety precautions during transport, usage, storage and disposal. Findings of the study indicate that by law, most countries have control over movement of hazardous materials, and they are subject to a variety of international treaties. Also different countries can use different class types for the same product. People who handle hazardous items are required to wear protective gear and metropolitan fire services often have a specially equipped response team to handle injuries and spills. It is seen from the case studies that many accidents are caused due to the noncompliance of safety measures. Laws and regulations on the use and handling of hazardous materials can vary depending on the material behaviour and status.

CHAPTER 1
INTRODUCTION

1.1 INTRODUCTION

Supply chain management is the process of planning, implementing, and controlling the operations of the supply chain as efficiency as possible. Supply chain management spans all movement and storage of raw materials, work in process inventory, and finished goods from point of origin to point of consumptions. The art of managing the supply chain and science of managing and controlling the flow of goods information and other resources like energy and people between the point of origin packaging in and the point of consumption in order to meet customer's requirements is called Logistics. It involves the integration of information, transportation, inventory, warehousing and material handling and packaging. Dangerous goods (DG), are substances that when transported are a risk to health, safety, property or the environment. Some materials and products that move by rail, ship, air or highway are classed as Hazardous product because they are flammable, explosive, toxic or harmful to people or the environment. It is important that hazardous material are detected correctly to insure proper storage, treating and disposal, federal regulatory agencies need manufacturers and distributors to recognize the physical, health and climate risks of their products in several ways. Placards, labels, marketing's, and MSDS (Material Safety Data Sheet) are just some of the means used to convey this information. Many commodities used by logistics are hazardous such things Can be serious and personals need not be aware of the domestics and international laws and regulation associated with them. These laws and regulations places special emphasis on communicating the dangerous linked with such goods because exposures can lead to severe personal injury, permanent illness and even death. It can also harm or kill Property and the environment. It is imperative that all workers know and appreciate the dangers connected with these Products. No single functional area is exempt from these risks to health, safety and property. 12 Logistics is the art of managing the supply chain and science of managing and controlling the flow of goods information and other resources

like energy and people between the point of origin packaging in and the point of consumption in order to meet customers requirements. It involves the integration of information, transportation, inventory, warehousing and material handling and packaging. Supply chain management is the process of planning, implementing, and controlling the operations of the supply chain as efficiency as possible. Supply chain management spans all movement and storage of raw materials, work in process inventory, and finished goods from point of origin to point of consumptions. Shipping hazardous goods is not an easy task. There are many things to take into account when it comes to packaging and labeling and goods treated in airports, ports and on United Nations vessels The Committee of Experts has issued guidelines concerning the transport of Hazardous substances. Such guidelines are adopted by the regulatory organization responsible for the different modes of carriage. All dangerous materials are recognized with a unique UN number. The regulation is based on a classification system that assigns substance or articles to one of nine classes. Class 1 is the high dangerous and least dangerous is class 9.

1.2 Classification of dangerous goods

Class1 Explosives

Class 2 Gases (flammable, non-flammable, non-toxic and toxic gases)

Class 3 Flammable liquids

Class 4 Flammable solids

Class 5 Oxidising substances, Organic peroxides 13

Class 6 Toxic and infectious substances

Class 7 Radioactive material

Class 8 Corrosives

Class 9 Miscellaneous dangerous goods

Class 1 - Explosives

Explosives are materials or items which have the ability to rapidly conflagrate or detonate as a consequence of chemical reaction.

DGI are proficient in handling explosives, Class 1 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of explosives; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Explosives are capable by chemical reaction of producing gases at temperatures, pressures and speeds as to cause catastrophic damage through force and/or of producing otherwise hazardous amounts of heat, light, sound, gas or smoke

Sub-Divisions

Division 1.1: Substances and articles which have a mass explosion hazard

Division 1.2: Substances and articles which have a projection hazard but not a mass explosion hazard

Division 1.3: Substances and articles which have a fire hazard and either a minor blast hazard or a minor projection hazard or both

Division 1.4: Substances and articles which present no significant hazard; only a small hazard in the event of ignition or initiation during transport with any effects largely confined to the package

Division 1.5: Very insensitive substances which have a mass explosion hazard

Division 1.6: Extremely insensitive articles which do not have a mass explosion hazard

Commonly Transported Explosives

Ammunition/cartridges, Fireworks/pyrotechnics, Flares, Blasting caps / detonators, Fuse, Primers, Explosive charges (blasting, demolition etc), Detonating cord, Air bag inflators, Igniters, Rockets, TNT / TNT compositions, RDX / RDX compositions, PETN / PETN compositions.

Class 2 - Gases

Gases are defined by dangerous goods regulations as substances which have a vapour pressure of 300 kPa or greater at 50°c or which are completely gaseous at 20°c at standard atmospheric pressure, and items containing these substances. The class encompasses compressed gases, liquefied gases, dissolved gases, refrigerated liquefied gases, mixtures of one or more gases with one or more vapours of substances of other classes, articles charged with a gas and aerosols.

DGI are proficient in handling gases, Class 2 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of gases; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Gases are capable of posing serious hazards due to their flammability, potential as asphyxiants, ability to oxidize and/or their toxicity or corrosiveness to humans.

Sub-Divisions

Division 2.1: Flammable gases

Division 2.2: Non-flammable, non-toxic gases

Division 2.3: Toxic gases

Commonly Transported Gases

Aerosols, Compressed air, Hydrocarbon gas-powered devices, Fire extinguishers, Gas cartridges, Fertilizer ammoniating solution, Insecticide gases, Refrigerant gases, Lighters, Acetylene / Oxyacetylene, Carbon dioxide, Helium / helium compounds, Hydrogen / hydrogen compounds, Oxygen / oxygen compounds, Nitrogen / nitrogen compounds, Natural gas, Oil gas, Petroleum gases, Butane, Propane, Ethane, Methane, Dimethyl ether, Propene / propylene, Ethylene.

Class 3 - Flammable Liquids

Flammable liquids are defined by dangerous goods regulations as liquids, mixtures of liquids or liquids containing solids in solution or suspension which give off a flammable vapour (have a flash point) at temperatures of not more than 60-65°C, liquids offered for transport at temperatures at or above their flash point or substances transported at elevated temperatures in a liquid state and which give off a flammable vapour at a temperature at or below the maximum transport temperature.

DGI are proficient in handling flammable liquids, Class 3 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of flammable liquids; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Flammable liquids are capable of posing serious hazards due to their volatility, combustibility and potential in causing or propagating severe conflagrations.

Sub-Divisions

There are no subdivisions within Class 3, Flammable Liquids.

Commonly Transported Flammable Liquids

Acetone / acetone oils, Adhesives, Paints / lacquers / varnishes, Alcohols, Perfumery products, Gasoline / Petrol, Diesel fuel, Aviation fuel, Liquid bio-fuels, Coal tar / coal tar distillates, Petroleum crude oil,Petroleum distillates, Gas oil, Shale oil, Heating oil, Kerosene, Resins, Tars, Turpentine, Carbamate insecticides, Organochlorine pesticides,Organophosphorus pesticides, Copper based pesticides, Esters, Ethers, Ethanol, Benzene, Butanols, Dichloropropenes, Diethyl ether, Isobutanols, Isopropyls, Methanol, Octanes.

Class 4 – Flammable Solids; Spontaneous Combustibles; 'Dangerous When Wet' Materials

Flammable solids are materials which, under conditions encountered in transport, are readily combustible or may cause or contribute to fire through friction, self-reactive substances which are liable to undergo a strongly exothermic reaction or solid desensitized explosives. Also included are substances which are liable to spontaneous heating under normal transport conditions, or to heating up in contact with air, and are consequently liable to catch fire and substances which emit flammable gases or become spontaneously flammable when in contact with water.

DGI are proficient in handling flammable solids, Class 4 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of flammable solids; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Flammable solids are capable of posing serious hazards due to their volatility, combustibility and potential in causing or propagating severe conflagrations.

Sub-Divisions

Division 4.1: Flammable solids

Division 4.2: Substances liable to spontaneous combustion

Division 4.3: Substances which, in contact with water, emit flammable gases

Commonly Transported Flammable Solids; Spontaneous Combustibles; 'Dangerous When Wet' Materials

Alkali metals, Metal powders, Aluminium phosphide,Sodium batteries, Sodium cells, Firelighters, Matches, Calcium carbide, Camphor, Carbon, Activated carbon, Celluloid, Cerium, Copra, Seed cake, Oily cotton waste, Desensitized explosives, Oily fabrics, Oily fibres, Ferrocerium, Iron oxide (spent, Iron sponge/direct-reduced iron (spent) , Metaldehyde, Naphthalene, Nitrocellulose, Phosphorus, Sulphur.

Class 5 - Oxidizers; Organic Peroxides

Oxidizers are defined by dangerous goods regulations as substances which may cause or contribute to combustion, generally by yielding oxygen as a result of a redox chemical reaction. Organic peroxides are substances which may be considered derivatives of hydrogen peroxide where one or both hydrogen atoms of the chemical structure have been replaced by organic radicals.

DGI are proficient in handling oxidising agents and organic peroxides, Class 5 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of oxidising agents and organic peroxides; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Oxidizers, although not necessarily combustible in themselves, can yield oxygen and in so doing cause or contribute to the combustion of other materials. Organic peroxides are thermally unstable and may exude heat whilst undergoing exothermic autocatalytic decomposition. Additionally, organic peroxides may be liable to explosive decomposition, burn rapidly, be sensitive to impact or friction, react dangerously with other substances or cause damage to eyes.

Sub-Divisions

Division 5.1: Oxidizing substances

Division 5.1: Organic peroxides

Commonly Transported Oxidizers; Organic Peroxides

Chemical oxygen generators, Ammonium nitrate fertilizers, Chlorates, Nitrates, Nitrites, Perchlorates, Permanganates, Persulphates, Aluminium nitrate, Ammonium dichromate, Ammonium nitrate, Ammonium persulphate, Calcium hypochlorite, Calcium nitrate, Calcium peroxide, Hydrogen peroxide, Magnesium peroxide, Lead nitrate, Lithium hypochlorite, Potassium chlorate, Potassium nitrate, Potassium chlorate, Potassium perchlorate, Potassium permanganate, Sodium nitrate, Sodium persulphate.

Class 6 - Toxic Substances; Infectious Substances

Toxic substances are those which are liable either to cause death or serious injury or to harm human health if swallowed, inhaled or by skin contact. Infectious substances are those which are known or can be reasonably expected to contain pathogens. Dangerous goods regulations define pathogens as microorganisms, such as bacteria, viruses, rickettsiae, parasites and fungi, or other agents which can cause disease in humans or animals.

DGI are proficient in handling toxic and infectious substances, Class 6 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of oxidising agents and organic peroxides; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Toxic and infectious substances can pose significant risks to human and animal health upon contact.

Sub-Divisions

Division 6.1: Toxic substances

Division 6.2: Infectious substances

Commonly Transported Toxic Substances; Infectious Substances

Medical/Biomedical waste, Clinical waste, Biological cultures / samples / specimens, Medical cultures / samples / specimens, Tear gas substances, Motor fuel anti-knock mixture, Dyes, Carbamate pesticides, Alkaloids, Allyls, Acids, Arsenates, Arsenites, Cyanides, Thiols/mercaptans, Cresols, Barium compounds, Arsenics / arsenic

compounds, Beryllium/ beryllium compounds, Lead compounds, Mercury compounds, Nicotine / nicotine compounds, Selenium compounds, Antimony, Ammonium metavanadate, Adiponitrile, Chloroform, Dichloromethane, Hexachlorophene, Phenol, Resorcinol.

Class 7 - Radioactive Material

Dangerous goods regulations define radioactive material as any material containing radionuclides where both the activity concentration and the total activity exceeds certain pre-defined values. A radionuclide is an atom with an unstable nucleus and which consequently is subject to radioactive decay.

DGI are proficient in handling radioactive material, Class 7 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of radioactive material; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Whilst undergoing radioactive decay radionuclides emit ionizing radiation, which presents potentially severe risks to human health.

Sub-Divisions

There are no subdivisions within Class 7, Radioactive Material.

Commonly Transported Radioactive Material

Radioactive ores, Medical isotopes, Yellowcake, Density gauges, Mixed fission products, Surface contaminated objects, Caesium radionuclides / isotopes, Iridium radionuclides / isotopes, Americium radionuclides / isotopes, Plutonium radionuclides / isotopes, Radium radionuclides / isotopes, Thorium radionuclides / isotopes, Uranium radionuclides / isotopes, Depleted uranium / depleted uranium products, Uranium hexafluoride, Enriched Uranium.

Class 8 - Corrosives

Corrosives are substances which by chemical action degrade or disintegrate other materials upon contact.

DGI are proficient in handling corrosives, Class 8 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of corrosives; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Corrosives cause severe damage when in contact with living tissue or, in the case of leakage, damage or destroy surrounding materials.

Sub-Divisions

There are no subdivisions within Class 8, Corrosives.

Commonly Transported Corrosives

Acids/acid solutions, Batteries, Battery fluid, Fuel cell cartridges, Dyes, Fire extinguisher charges, Formaldehyde, Flux, Paints, Alkylphenols, Amines, Polyamines, Sulphides, Polysulphides, Chlorides, Chlorosilanes, Bromine, Cyclohexylamine, Phenol / carbolic acid, Hydrofluoric acid, Hydrochloric acid, Sulfuric acid, Nitric acid, Sludge acid, Hydrogen fluoride, Iodine, Morpholine.

Class 9 - Miscellaneous Dangerous Goods

Miscellaneous dangerous goods are substances and articles which during transport present a danger or hazard not covered by other classes. This class encompasses, but is not limited to, environmentally hazardous substances, substances that are transported at elevated temperatures, miscellaneous articles and substances, genetically modified organisms and micro-organisms and (depending on the method of transport) magnetized materials and aviation regulated substances.

DGI are proficient in handling miscellaneous dangerous goods, Class 9 Dangerous Goods. DGI have the ability to service all customer requests pertaining to the logistics of miscellaneous dangerous goods; packing, packaging, compliance, freight forwarding and training.

Reason for Regulation

Miscellaneous dangerous goods present a wide array of potential hazards to human health and safety, infrastructure and/ or their means of transport.

Sub-Divisions

There are no subdivisions within Class 9, Miscellaneous Dangerous Goods.

1.3 Global regulations

UN Guidance on the Transport of Dangerous Goods Model Regulations (TDG Model Regulations) is a guideline document drawn up by the United Nations to unify the development of national and international regulations regulating the different modes of transport of dangerous goods (air, road and sea). On the basis of this Model Regulation, most dangerous goods regulations such as the IMDG Code, the IATA and other national regulations are established.

1.3.1 Dangerous Goods Regulations(DGR)

The IATA Dangerous Goods Regulations (DGR) is the trusted source to help us to prepare, Manage or approve shipments of hazardous goods by air. Some objects can endanger the safety of an aircraft or individuals on board, and the transport of these hazardous materials by air may be prohibited or limited. The IATA DGR manual is the global guide for the transportation of hazardous goods by air, and the only Standard that airlines accept. The content contains up-to-date information on effective and efficient regulations, which ensures the safe transport of hazardous materials by air. This manual is the Product of IATA working closely representatives of the airline members, local governments and ICAO. All parties involved in the carriage of dangerous goods by air such as airlines, freight forwarders, ground handlers, manufacturers, and shippers may benefit from the use of the DGR. The aim of DGR is preventing undeclared dangerous goods from being loaded on an aircraft and passengers from taking on board those dangerous goods which they are not permitted to have in their baggage, cargo and passenger acceptance staff should seek confirmation from shippers and passengers about the contents of any item of cargo or baggage where there are suspicions that it may contain dangerous goods.

1.3.2 **IMDG CODE**

The International Maritime Dangerous Goods or IMDG Code was adopted in 1965 according to the 1960 IMO SOLAS (Safety for Life at Sea) Convention. The Transportation of dangerous goods by sea is governed by IMDG Code to prevent injury to individuals or harm to vessels and their cargoes. Carrying of marine pollutants is mainly regulated to avoid damage to the marine ecosystem. The aim of the IMDG Code is to improve the safe carriage of hazardous materials while facilitating the unrestricted

free movement of such goods. The IMDG Code includes description of all the many dangerous cargoes available for carriage by ship and contains solid, liquid and gaseous substances. Explosive, flammable, oxidizing and radioactive compounds are also included and their containment methods recommended or packaging are specified, as are all other related product details. The code is to be revised in the future on two-year basis, are foreseen in order to take into account technological developments.

1.3.3 HAZMAT

HAZMAT is short form for ―hazardous materials‖—substances which can present a fair risk to health, property, or the climate. HAZMATs involve such substances as toxic chemicals, fuels, nuclear waste products, and biological, chemical, and radiological agents. HAZMATs may be released as liquids, solids, gasses, or a combination or form of all three, including dust, fumes, gas, vapour, nebula, and smoke. HAZMAT spills have caused human or animal health problems, injuries, and even deaths and damaged buildings, houses, properties, and the environment. It is fair to believe that one cannot experience such dire consequences of HAZMAT every day. The fact is, many goods contain dangerous materials Chemicals are used and processed in homes 16 on a regular basis and are transported on a daily basis through Highways, railways, waterways, and pipelines. HAZMAT is regulated to promote their safe handling, storage, transportation, and disposal to help prevent HAZMAT incidents. Each year thousands of events occur in which HAZMATs are released into the environment due to injuries or natural disasters. Besides potentially harming people and the environment, spills in coastal waters can lead to significant disruption of marine transport with potential widespread economic impact. Both coastal and inland spills are known as HAZMAT accidents, and are regularly addressed by first responders such as fire fighters and local law enforcement.

1.3.4 Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

The Globally Harmonized Chemicals Classification and Labelling System (GHS) is an globally accepted system administered by the United Nations, developed to replace the multitude of commonly used hazardous material classification and labelling systems around the world. The Key elements of the GHS include standardized hazard check standards, common warning pictograms, and harmonized safety data sheets that provide

variety information to consumers of hazardous goods. The system acts as a complement to the UN Numbered system of regulated hazardous material transport. Implementation is managed through the UN Secretariat. The objective with GHS is to develop a single, globally harmonized system to address classification of chemicals, labels and safety data sheets. It aims at ensuring that information on physical hazards and toxicity from chemicals is available in order to enhance the protection of human health and the environment during the handling, transport and use of these chemicals.

1.3.5 International Carriage of Dangerous Goods by Rail (RID)

New legislation relating to International Carriage of Dangerous Goods by Rail (RID) was created. The Latest regulation comes in to effect on 1 January 2019. The latest legislation involves revised classification codes, new packing instructions and testing of specific gas cylinders. The objective was to maintain the safety of persons and property in rail operation. The 2019 edition is a replacement for the 2017 edition. However, a transitional period allows the provisions of RID 2017 to be used until 30 June 2019. RID refers to the international carriage of dangerous goods by rail between the 44 existing RID Contracting States in Europe, Asia and North Africa.

1.4 OBJECTIVES OF THE STUDY

- To analyze the challenges in handling of HAZMAT.
- To study the various protection equipment required to be used while handling Hazardous cargo.
- To understand the role of safety in creating positive working environment.
- To study the modern trends in hazardous material handling and its impacts.
- To analyze the challenges in handling of HAZMAT.
- To study the feedback of the employees about handling of hazardous products and their safety.

1.5 SCOPE OF STUDY

This study was conducted to know about the safety measures in movement of the hazardous materials and innovative techniques in this area. This research plays a sequent role in gathering information's about the internal and external work procedures and helps in attaining employee feedback and satisfaction

1.RESEARCH METHODOLOGY

Research methodology is the science of how research is done scientifically. It's a way to systematically and logically solving a problem and helps us to understand the process and product of the research. To accomplish the above said objective the important information is being taken by utilizing both the primary and secondary data. This study uses extensive secondary data from public domain to analyze the Handling of Hazardous Cargo, safety measures implemented by companies and carry out a comparative analysis. The data has been collected from research papers, public reports, journals, company websites, reference books, newspaper articles and Industry magazines. Some information collected has been pictorially represented. The data so called is interpreted and analyzed with reference to the project tittle.

1.7 LIMITATION OF THE STUDY

The study had mainly done on the basis of the secondary data as well as primary data available in the reports, journals and company websites. Rather than giving a wide picture on the hazardous cargo the study is restricted only to the safety measures in movement of the hazardous materials with in the logistics companies

. • Some of the respondents in the questionnaire didn't respond accurately

• Lack of time Personal visit to the firm and personal interaction with the workers was not feasible.

CHAPTER 2

REVIEW OF LITERATURE

2.1 REVIEW OF LIETATURE

The below reports and articles online journals were studied and referred for the project.The source from which these information's is collected are given.

SIGNIFICANCE OF SUPPLYCHAIN MANAGEMENT

Supply chain Management (SCM) is a significant piece of each association, regardless of whether little or huge. SCM is the dynamic administration of storing materials to amplify client esteem and accomplish a practical upper hand. SCM likewise manages thedevelopment and storing of materials expected to make an item, just as stock administration, and monitoring completed merchandise from where they were made to who they go to.

Current supply chain management includes the essential arrangement of start to finish business cycles to acknowledge market and financial worth, just as giving a firm the upper hand over their business rivals. Supply chain management massively affects business. Great SCM can straightforwardly further develop client care. The right item and the right amount should be conveyed in an ideal way, to assuage the two makers andmerchants. customers need to have the option to know the area they should go to acquirethe products that they need. Consumers likewise need an elevated expectation of client assistance. In the event that merchandise are not disseminated on schedule, supply chainmanagement of an organization need to guarantee them that they will get their items as quickly as time permits. SCM additionally gigantically affects the main concern of an organization.

A decent supply chain management executives can work on the productivity of plants, distribution centers, and transportation vehicles. Income is straightforwardly expanded on the grounds that the conveyance of an item is in an

opportune way, and shoppers canbuy their products.

WAREHOUSE PERFOMANCE MEASUREMENT

As the supply chains get more complex, the variety of indicators and tools to measure warehouse performance has also increased. Furthermore, the metrics that are used for performance evaluation are assessed in different manners and hence there is not clear definition for some of these metrics. To address these issues, this literature review focuses on operational warehouse performance measurement, for which the warehouse managers need to carry out periodic analysis. Using the content analysis method,performance indicators are acquired from selected papers and are classified according totime, cost, and quality and productivity dimensions. The contributions of this literature review are as follows: we present a synthesis of the literature on operational warehouse performance, we provide the definitions for the performance indicators and a frameworkto demonstrate their boundaries and, finally, based on the literature analysis, we also provide some discussions on current trends in warehouses and propose future research directions on warehouse performance evaluation.

HUMAN FACTOR AS THE MAIN OPERATIONAL RISK IN DANGEROUS GOODS TRANSPORTATION

Risk management is one of the key issues during planning safe handling and transportation of Dangerous Goods. Examining risks by means of semi-quantitative riskassessment method it allows to focus strictly on operational risks that are resulted by activities of different parties within Dangerous Goods transportation chain. There are plenty of activities when handling and transporting Dangerous Goods that are consideredas incidents but do not necessarily lead to accidents When packaged dangerous goods (DG) are transported by road, it is difficult to follow both legal requirements as well as meet suggested safety

regulations in order to prevent accidents during activities with chemicals that are harmful for man, assets and environment. Due to the fact that there are multiple parties involved into handling and transportation procedures, plenty of different risks can occur during these activities with Dangerous Goods. As the importance of human factor has been underestimated, this paper discuss about analysing different types of risks within a dangerous goods transportation chain related to specificparticipant. This paper concludes that the human factor has a considerable impact on ensuring safety in Dangerous Goods Transportation. The number of Dangerous Goods operational risks of different parties and detailed operational risks assessment confirm that human factor is one of the crucial factors why incidents turn into accidents. Accidents within the Dangerous Goods transportation chain are caused mainly due to thenumber of party's involved, repetitive nature of operational risks at parties involved andthe possible consequence of an event.

FIRE SAFETY MEASURES IN WAREHOUSES

The paper discuss about fire safety measures in warehouses. Losses that occur during fire in warehouses can be extremely high due to the amount of storedgoods. Beside the loss of the goods, fires in warehouses represent danger for the staff working in it, especially for staff members which get caught in middle of a spreading fire. This Paper First Explained and listed various fire sources which include Fuel (which represents the burning material, materials like paper or gasoline), Oxygen(which can be found in the air and it is required for combustion) , Energy (whichraises the fuel temperature to the level for fire ignition) then Factors that affect fire ignition, fire spread and fire extinguishing were analysed. Finally,

fire protection measures were given in order to increase the level of fire safety and health at work in warehouses. In fire protection this paper suggests various measures first measure which should be considered to construction material used for warehouses. Because of high levels of heat-resistance, the most suitable materials are concrete and steel covered with plaster or fibrous silicate panels. Next measure is the usage of big, massive wooden beams because of their slow combustion and structural stability compared to uncoated steel construction. It also discuss about warehouse ventilation system, Automatic Fire detection system in order to provide 24 hour fire detection possibility and Automatic extinguishing system. So the conclusion of the paper is that Fire breakouts can have severe consequences on the reputation of the warehouse management. It can threaten future business plans which can endanger recovery. Because of that, warehouses are very sensitive to fire risk and in order provide proper safety in the warehouse, exceptional safety measures have to be applied.

IMPACT OF HAZMAT ON BUSINESS

Shipping and handling of unsafe materials (hazardous materials) can have genuine operational, monetary and natural implications for transporters.

With a huge number of things delegated "perilous" and guidelines proceeding to extend, moving hazardous materials securely and in consistence is more critical in stage than anything else. Tragically, numerous associations put their organization's operational effectiveness, cutthroat spryness, notoriety and primary concern in danger by not having the essential framework and preparing to guarantee consistence across the supply chain.

Keeping a smooth inventory network is important in the present exceptionally aggressive market. However, regardless of the significance (and by and large effect) of consistence on the supply chain management, there is an overall absence

of certainty amonghazardous merchandise (DG) experts in the capacity of their associations to meetchanging consistence orders. Truth be told, a new Label ace review tracked down that 51% of DG experts think that its difficult to stay aware of the most recent guidelines, and15 percent were NOT sure that they can guarantee DG administrative consistence acrosstheir association (13% were uncertain).

CHAPTER 3

HAZARDOUS CARGO HANDLING

3.1PROCEDURE OF TRANSPORTATION OF CARGO

3.1.1 PRE-HAZARDOUS APPROVAL

The process begins when the shipping line is approached by the customer for Hazardouscargo approval. Most lines have their own unique models for Hazardous cargo applications. Customer need to fill in every fields in the specific template sheet and sendto the shipping line. It is necessary for the shipping line to ensure the acceptance of the hazardous goods at transshipment or ports that the vessel calls because someports do not welcome vessels carrying high risk cargoes like Class 1 or Class 7 to accesstheir ports or enter without taking safety precautions. Only after these procedures are done and confirmation is received from all quarters, the dangerous booking can be approved by the shipping line and client will be given the booking and empty container release.The shipping line, most of which currently have a specialized Dangerous desk or Dangerous cargo center will verify that all the information provided by the shipper is correct (The shipping lines would use the IMDG Code to verify the accuracy of the information submitted). The DG Desk will search for hazardous cargo space on the vessel assigned to carry this Dangerous cargo once the information provided by the client have been checked and found to be correct. Typically, every vessel has a set limit on how many and what sort on hazardous cargoescan be carried on board a ship. This may vary from vessel to vessel, line to line, port to port and also depends on the cargo already on board. If the hazardous desk in coordination with the operating desk ensure that there is adequate capacity on the ship to hold the particular type of hazardous cargo, and that this cargo is allowed to Pass through the various ports that it may call, it will give the go ahead to the export desk/client that the Hazardous cargo is acceptable.

3.1.2 POST-HAZARDOUS APPROVAL

When the container is assembled in compliance with the hazardous requirements, the container will be transported as normal to the container terminal during the stack period. Certain ports may require special documentation for all dangerous goods entering their gates/stacks. It is for the port to check that this container is a dangerous container and move it to the designated dangerous stacking spot within the port area. The Required hazardous labels must be placed to all 4 sides of the container without fail. Port and shipdo not approve any Dangerous container into the port without the labels.

The dangerous packing declaration must be filled in by the customer and sent to the shipping line before the container is loaded onto the ship. This all the information relevant to the dangerous Cargo being Transported. The shipper must be patient and vigilant in filling up because misrepresentation of dangerous goods has severe consequences for the lives of many in the people in the port, ship and carriers who manage this container along their route from Point A to Point B. If by any chance there was a difference between the cargo details during the time of application and during the time of packing, it is the shipper‘s obligation to verify that theshipping line is informed of this change immediately. Dangerous approvals may be re- applied before the vessel arrives for loading. If not, it will need to wait for the next ship.

3.1.3 POST LOADING

One copy of the Dangerous packing declaration is always available on board the ship. The shipping line also submits a separate Dangerous cargo manifest detailing ALL dangerous cargoes that are on board each of which will have its own dangerous packingdeclaration. It is necessary to aware that there is a difference

between stowage and segregation and this can only be done effectively once the shipping line, port and transporter have all the information correctly provided. It is very essential for the line toknow what the cargo is and how it is packed not only to know that the cargo is well protected for transportation but also to find out what kind of actions to take should something happen on board. This form of action may depend on materials involved.

3.2COMPANYS HANDLING HAZARDOUS GOODS

3.2.1KUEHNE+NAGEL INTERNATIONAL

Kuehne + Nagel International is a global transport and logistics company based in Switzerland. It was founded in 1890, in Germany, by August Kühne and Friedrich Nagel. It provides sea freight and airfreight forwarding, contract logistics, and overland businesses to ensure the safe and compliant handling of dangerous goods, kuehne + Nagel use robust processes, clear instructions, training, and monitoring. This ensures that employees of Kuehne + Nagel‘s have the expertise and knowledge required to carry outtheir duties in a secure and professional manner, in compliance with all relevantlegislation. The company‘s global Hazardous goods guidelines are enforced by a networkof experts located in all business units around the world. The guidelines are aimed at reducing or minimizing the risk of all forms of hazardous goods, both in transport and storage.

3.2.2APL LOGISTICS LIMITED

APL Logistics Ltd is a wholly owned subsidiary of Kintetsu World Express, Inc. (KWE), a Japan-based freight forwarding and transportation company. As a global supply chain specialist, APL Logistics does business in more than 60 countries. Headquartered in Singapore, APL Logistics has locations across the globe. In 1980, in response to the increasing importance of Asian imports, U.S.-based

container transportation and shipping company APL has created American Consolidation Services(ACS) to meet the needs of importers seeking assistance in managing the flow of their Asian goods. APL Logistics specialized in Transportation of Hazardous goods which many other forwarders cannot manage. APL team of specialized professionals who have worked forestablished airlines and shipping lines within the dangerous goods freight industry. To handling of dangerous cargo requires a very professional approach, which requires experienced employees. APL Logistics has trained and skilled staff to handle this shipping. There are several companies in India that are producers, as well as importers and exporters for chemicals and other hazardous equipment and APL gives moreimportance to handling these risky shipments.

3.2.3 FEDEX

FedEx Corporation is an American multinational delivery services company incorporated October 2, 1997. The company is known for its overnight delivery serviceand pioneering a program that can monitor shipments and provide real-time alert on package position, a feature that most other carrier companies have now introduced. FedEx is also one of the top contractors of the US government. In January 2000, FDX Corporation changed its name to FedEx Corporation and re-branded all of its subsidiaries FedEx Express is a world leader in the shipment of Hazardous goods and has specialists on staff to assist with dangerous goods questions. Dangerous goods transport must be tendered to FedEx Express in compliance with existing International Air Transport Association (IATA) legislation for air transport and the FedEx Express Terms and Conditions. It is necessary regardless of the routing, and whether the shipment ends up physically moving by air , land or a combination of these.

3.3HANDLING OF DANGEROUS GOODS

Dangerous Goods are substances which put people, property and the environment at immediate risk. These substances can be explosive, flammable, oxidising, toxic, radioactive or corrosive. Since hazardous goods pose a variety of risks to individuals, property and the environment, it is very important that you treat them safely and in a manner that minimizes the risks they can pose to your workplace.

Due to the higher use of Hazardous products in the previous century, chemical Producers now package their Hazardous goods in much bigger packages. Now a days it is not rare to see Hazardous goods such as acids and flammable liquids in packages as big as 205L drums and 1000L Intermediate Bulk Containers. Failure to handle these large packages with the right equipment can affect severe damage to people and property.

3.3.1SAFETY DATA SHEETS

To ensure that everyone on the job is aware of the particular risks related with the hazardous substances that they are deal, it is very necessary to have a copy of the safety data sheets for each Hazardous substance. Safety data sheets are documents that outline the specific reactivity, fire, health and environmental dangers related with a particular substance. The safety data sheet will also outline the basic storage and handling requirements for the particular substance. Before a dangerous substance is dispensed or used, the safety data sheet for the substance must be consulted to ensure that the dangerous substance is managed in the safest manner.

3.3.2 FORK LIFTS

A **forklift** (also called **lift truck**) is a powered industrial truck used to lift and move materials over short distances.

If the company procures their Hazardous goods in 1000L intermediate bulk containers (IBC's), a forklift must be used to lift these IBC's in and out of chemical storage containers. 205L drums have a rounded shape and are much more difficult to handle. Forklift attachments must be used when moving these drums in and out of chemical storage containers.

3.3.3PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment (like gloves, Respiratory Equipment) is another form of protection that can be used to protect people and properties from the risks Hazardous goods. The use of personal protective equipment when dispensing and handling toxic and corrosive substances is particularly important. Toxic substances are substances which damage human health when they enter the body. The means by which harmful substances come into the body are called exposure paths. There are 3 principal routes ofexposure. They are Ingestion, Skin contact, Inhalation. Among these three inhalations isthe most common type. To minimize the risk of exposure to toxic substances, it is necessary to use the appropriate personal protective equipment such as respiratory equipment and gloves while handling and dispensing toxic substance.

3.4SAFETY MEASURES REQUIRED IN WAREHOUSE

3.4.1SAFE LIFTING TECHNIQUES

If a load needs transporting, firstly decide what approach is the best choice for its movement. If lifting is the most suitable method check the route to ensure that there are no obstacles in the way and ensure that there is an adequate room for loading at its destination. Safe lifting procedures should always be carried out and the load does not block the view of the lifter. Using all materials handling equipment carefully and follow the appropriate operating procedures including pushing instead of pulling, wherever possible and lean in the direction you are going. Also, never operate a forklift or use other driven equipment without training or permission.

3.4.2LABELING HAZARDOUS ZONES

Hazardous equipment should be stored away in a place that is clearly labeled and secure walk ways should be highlighted by appropriate signage. The best way to highlight dangerous zones is by using tape or painting black and white lines on the floor of the specified area. This allows staffs to be aware of dangerous environment and can be helpful in preventing incidents that can cause severe injury.

3.4.3USE OF SAFETY EQUIPMENT

Forklifts or hydraulic dollies are used to lift objects that are too heavy is very importantequipment in the warehouse. proper eyewear and hard hats should also be worn when needed. Employees should be mindful of emergency exits and the sprinklers built in theroof should not be blocked at any time. Safety equipment is installed in order to reduce workplace injury. it may be time consuming to initiate its use but it does pay off in the long run.

3.5CASE STUDY ON BEIRUT EXPLOSION 2020

On 4 August 2020, a gigantic blast shook the city of Beirut, breaking glass and causing broad harm to structures and framework inside a range of three kilometers. Hundreds were killed, and a large number of individuals harmed. The effect of this extraordinary blast, which enlisted as a 3.3 greatness tremor, was felt as far away as Cyprus. The blasthappened because of the inadvertent ignition of 2,750 tons of ammonium nitrate, whichhad been put away in the Beirut Port region for various years under entirely lacking conditions. The blast influenced a thickly urbanized region which is, from numerous points of view, the heart and soul of Beirut - a rich blend of homes, little shops and organizations, scattered with the brilliant engineering of a portion of the city's key legacylocales that had endure the common war.

The blast seriously harmed two of Beirut's five medicinal clinics - one of which was a committed Coronavirus needs. This extended the city's general crisis ability as far as possible, and implied that the leftover clinics had the option to treat just the most seriously injured. In what can be viewed as a horrendous inversion of the exemplary situation of a nature-based disaster setting off a man-made calamity, the Beirut Port blastdrove thusly to a blast in
Coronavirus cases, similarly as the pandemic circumstance was getting leveled out. Furthermore, although in this specific case there may have been less primary harm and less quick fatalities than following a fiasco like an earthquake, the irony is that man- created calamities can frequently be moderated or forestalled.

3.5CASE STUDY ON SRILANKA SHIP FIRE 2021

Sri Lanka is gazing at an environmental fiasco.

On May 20, a fire emitted on a container, MV X-Press Pearl, moored at a distance off ofaround 9 nautical miles northwest of Colombo. The Singapore-hailed vessel was stackedwith 1,486 compartments conveying 25 tons of nitric corrosive and different synthetic compounds just as crude materials to make plastic packs. The ship was likewise carryingabout 300 tons of fuel in its tanks. The fire, which seethed for a fortnight, has been soaked. An endeavour by rescue specialists to tow the ship into more profound waters tocontain the harm to the coastline bombed when the vessel started sinking on June 2.

“An environmental emergency of this nature causes significant damage to the planet bythe release of hazardous substances into the ecosystem,” UN Resident Coordinator in SriLanka Hanaa Singer-Hamdy said in a statement. “This, in turn, threatens lives and livelihoods of the population in the coastal areas.”

Huge loads of microplastic granules have immersed the South Asian country's renowned sea shores in Negombo, a well- known vacationer location, constraining a fishing boycott and provoking feelings of environmental harm. Media reports have saidin excess of 50 turtles and eighteen dolphins have been discovered dead across the islandsince the ship burst into flames on May 20.

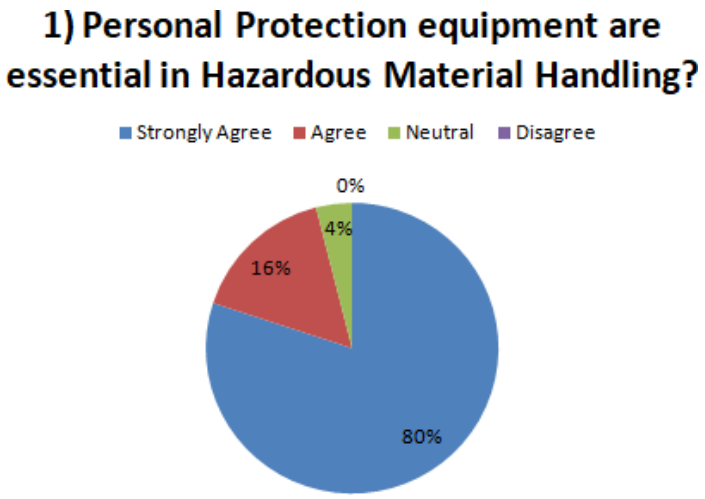
CHAPTER 4

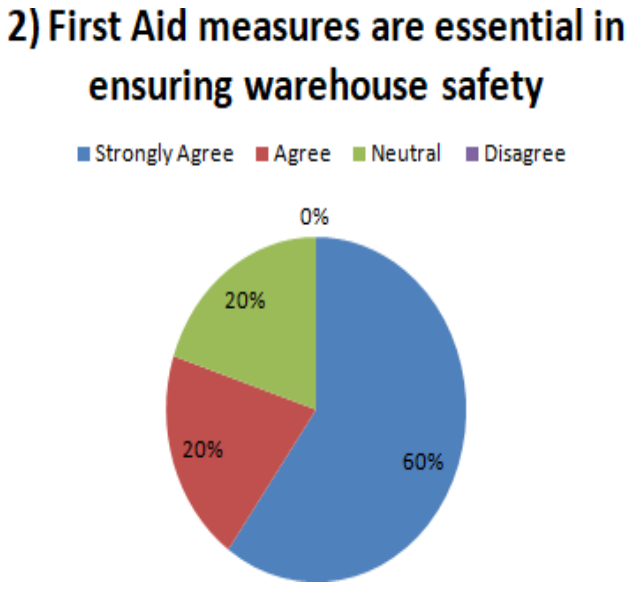
DATA ANALYSIS AND

INTERPRETATION

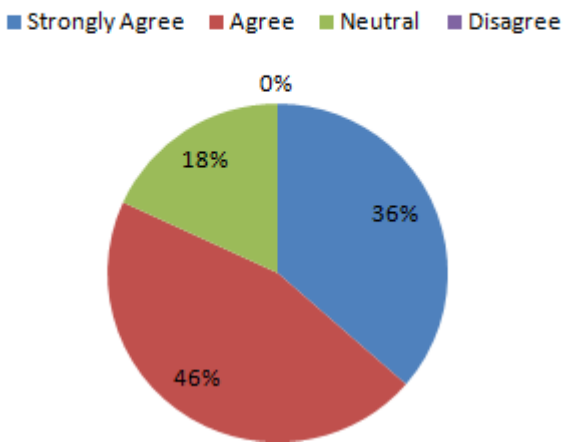
4.1 PERCENTAGE ANALYSIS METHOD

A percentage analysis method is a display of data and information that specifies the percentage of observations that exist for each data or grouping of data points. It is a particularly useful method of expressing the relative frequency of survey responses andother data and information. A questionnaire was prepared and given to employees and 25 responses was gathered.

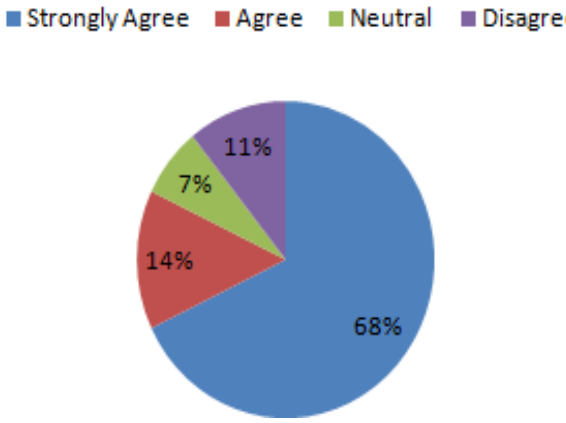


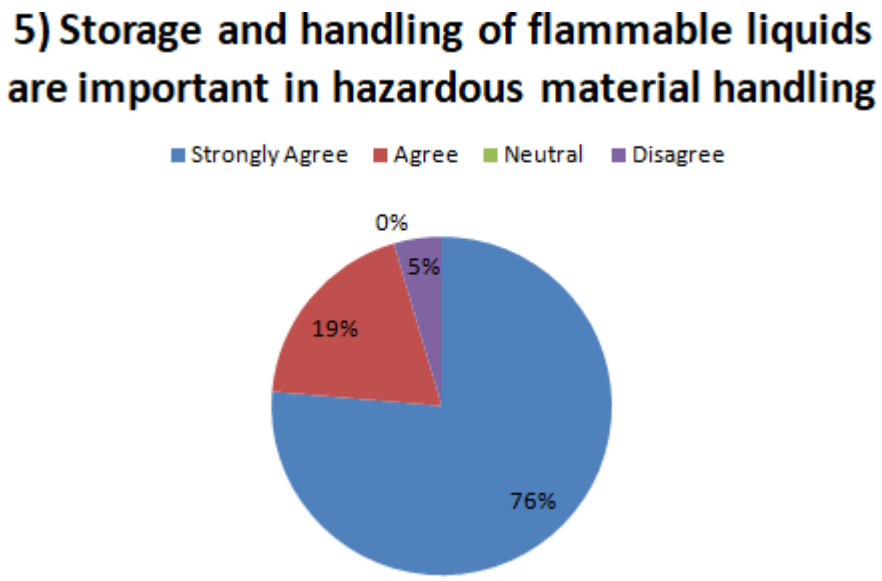


3)Conveyor systems are used in material handling?



4)Communicating chemical hazards to employees under the laboratory standards is essential to ensure safety





4.2 FINDINGS FROM ANALYSIS

1. It has been found that majority of employees (80%) strongly agree and 16% agree that the Essential of personnel protection in hazardous material handling.
2. Respondent (60 %) strongly agree that ensuring the warehouse safety first aid measures areessential for it.
3. When it comes to the opinion about conveyor system. Most of employees (36.7%) stronglyagree with conveyor system are used in material handling.
4. In the case of communicating chemical hazardous to employees under the laboratorystandard majority of employees strongly agree (68%) and the rest agree that it is essential toensure safety.
5. Majority of employees (76%) agree that flammable liquids storage and handling are important in hazardous material handling,

CHAPTER 5

FINDINGS, SUGGESTION AND CONCLUSION

5.1 FINDINGS

Based on the data and information collected in the course of study the observations are summarized below as findings.

- Carriage of Dangerous Goods by Rail (RID) and IATA Dangerous Goods Regulations (DGR)
- Most of the Accidents happened in warehouses due to the non-compliance safetymeasures
- Hazardous goods are classified into 9 classes where Category 1 is the most dangerous and category 9 is the least dangerous. Classification of hazardous materials can help in controlling accidents at work place.
- Lack of regular training and inspection also lead to non-compliance of safety.
- Another reason for accidents is Mis-declaration of cargo. The owner of Cargo maynot describe the cargo is dangerous goods, so that the shipper store that cargo withgeneral cargo. General cargo sometimes react with general cargo or the stored areadoes not have the feature to keep that dangerous goods so that it will cause for accidents.
- The Warehouse should have a basic safety feature like compartmentalize chemical substances for keeping large quantities of highly inflammable chemicals separately.
- Lack of Training Personnel is also another reason for accidents because the accident is happened first due the negligence of personnel or unawareness of personnel

5.2 SUGGESTIONS

- Don’t over load material handling equipment’s. Adequate guards and safety devices can help to provide safety to the material handling equipment
- Material handling equipment’s’ operator should be properly trained; -Beforehandling material, the operators must be trained.
- Keep material handling equipment’s in proper condition and don’t use defectiveequipment.
- Use proper personnel protective gears while handling hazardous materials.
- Avoid excessive weights In this case of material handling one of the importantthings to provide safety is avoid excessive weights it can lead difficult to handling material.
- Carefully consider feedback and suggestions from staff concerning practices that could further improve logistics efficiency.
- Always use cranes for lifting heavy hazardous equipment’s.
- Use mechanical handling equipment for difficult handling activities and to handling dangerous/hazardous material; -In the case of difficulties, handling must be use mechanical handling equipment.

5.3CONCLUSION

In the wake of contemplating different hypotheses and surveys it is presumed that the significance of safety measures in Hazardous materials assumes a significant part in this day and age. At Global Hazmat, there are numerous organizations in various businesses that arrangement with risky materials consistently. From corner stores to home cleaners, to mechanical plants to shippers, laborers are oftentimes dealing with risky products that can bargain their safety and the security of others around them if not took care of appropriately and in understanding to guidelines. This is the reason safety measures in hazardous material is so significant. The main justification the security measures in risky materials and hazardous merchandise is to guaranteethe wellbeing and security of laborers, working environments, properties and the climate. Each danger accompanies its own results and damage potential.

Based on the case studies, news reports and journals it is shown that many accidents caused due to the non-compliance of safety measures. The warehouses and companies should follow the guidelines and principles issued by theauthority. When these accidents have affected not only to the company but alsoto the people and environment the safety measures have greater importance in the dangerous goods handling. While rehearsing wellbeing estimates it won't just lessen mishaps yet in addition increment the efficiency, getting more business and decrease of environment contamination.

This study concludes that organizations managing in perilous material ought to strictly consent to the guidelines and movement of cargos should be according to IMDG rules. It is seen that most of organizations are in consistence with theabove mentioned and furthermore that awareness about the HAZMAT is developing.

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