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MSc IN SHIPPING MANAGEMENT

“FRAMEWORK OF ISO 14000 ON SHIPPING OF HAZARDOUS CARGOES”

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Thesis

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- Maria Karakasnaki (Supervisor)

- Konstantinos Chlomoudis

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Prologue – Methodology

For the development of the current thesis extensive use of bibliography was conducted for each respective part. For the section of hazardous cargoes (Ch. 2), we looked on the International Maritime Dangerous Goods (IMDG) Code on the site of the International Maritime Organization (IMO) and some relevant shipping & transportation sites, while its main contents are included in the appendixes' section. Furthermore, we looked on maritime and specific content sites, as well as some particular journals to have an elaborate insight on the main hazardous cargo types, their properties, effects to their environment and their vessels for transportation. For the accident examples (Ch. 3), which can be used as case study, we searched their history on marine/maritime sites, and added information from news history and sites of involved authorities (e.g. the EPA) to give conclusions about the accidents' causes, environmental effects and long – term aftermath outcomes. On the section of the International Organization for Standardization, the ISO 14000 family of standards and its implications on shipping, we looked on the ISO's official site and its available publications to present the organizations history, basic structure and purpose. As for the description of the main standards (focusing on ISO 14001 in particular), we use additional information from scientific articles and books related to standardization. Then we follow a similar approach on commenting the significance of ISO 14000 in shipping, using material from earlier, similar thesis works, so that we can give safe and clear conclusions for the subject and our thesis overall. Lastly, we used Wikipedia for the very basic information of our contents, while looking on each article's citations for further comprehensive information.

Abstract

The present Thesis aims to showcase the ISO 14000 series of standards in a comprehensive way, and centering to the matter of dangerous (hazardous) goods carried by merchant ships. Firstly we will refer to the main types of hazardous cargoes and their means of transportation by sea, and give examples of notorious marine accidents involving these kinds of cargoes. Then we will describe the framework of ISO 14000 on environmental protection and its relevance to shipping and dangerous cargoes. Finally, we will refer to the obligations of shipping companies, authorities and other organizations in regards to management of hazardous cargoes and environmental protection. The main content of the thesis will also be accompanied with elaborate figures of hazardous goods' signs (divided in categories) and tables of standard and codes. Thus we will be able to provide a comprehensive overlook on the ISO standards related to hazardous materials and their proper management.

Keywords: Hazardous cargoes, shipping, pollution, environment, ISO 14000, standards, regulations, environmental management, safety

Chapter 1: Introduction

The most widely used means of transportation of almost all goods nowadays is sea shipping from (virtually) the beginning of our history to today. Actually in modern times more specialized vessel types appear, each one designed to carry a specific type of cargo and they have different specifications, operational modules and required knowledge and skills from the crew. There are crude oil tankers, chemical tankers, dry cargo bulkers, containerships, gas carriers, and so on. Mishandling of dangerous cargoes can lead to serious accidents, with severe consequences to human life and health, property of the company or third parties, and to the environment (including natural habitats, flora and fauna). Various accidents have been occurred the last four decades, and that led to an ever-growing need for regulation of ship operations. Apart from accidents, the matter of waste disposal is also noticeable. Those accidents have occurred mainly as a result of the human factor, in terms of navigational errors, improper cargo handling, management issues of the company ashore etc.

International organizations like the IMO and ISO, in cooperation with state authorities and private initiatives, made significant efforts on defining and imposing certain standards and codes regarding safety management of vessels, handling of cargoes and environmental protection. Apart from the regulations and guidelines, companies can develop new strategies or improve their existing ones, perform internal audits for self – assessment, gather data and then proceed with an improvement plan. Here our reference is the ISO 14000, which is a series of standards about environmental management, where organizations can reduce their operations' adverse effects to the environment, comply with applicable laws and regulations and finally improve in the above. Given also the significant competition that already exists in the shipping market, shipping companies have to dedicate themselves into good environmental management at all ways, in order to reduce their adverse effects to the environment, reduce long – terms costs, build a 'pristine' environmental profile to the media, authorities and clients, and finally strengthen their position in the competitive shipping market. In this thesis we will describe the basics about hazardous cargoes and some examples, present some examples of accidents and then go on describing the framework of ISO 14000 standards and show its significance in shipping industry.

Through this particular thesis, we wish to contribute on a better understanding of standardization processes and regulations in terms of hazardous cargo transportation and environmental management. To understand the scope of the thesis overall, we firstly make an introduction on the most common dangerous cargoes and their appropriate transportation vessels, considering the fact that those cargoes belong to the most important commodities of the shipping market. This information can be useful to anyone who wishes an elaborate introduction in transportation of goods by sea and its common dangers. In addition, our available information on maritime accidents, their causes and consequence will help us understanding the above.

Furthermore, we can offer a comprehensive introduction on the ISO as an organization and its purposes, describing the main standards as well. In particular, we aim to introduce the ISO 14000 family of standards and ISO 14001, which aim to make companies develop their environmental concerns, reduce adverse effects to the ecosystem and improve their public image. Therefore, we aspire to demonstrate the significance of this kind of environmental certification for shipping enterprises, given the latest trend in the ever – demanding global market, and the regulations imposed by international organizations and regional authorities. The importance of the ISO 14000 in the shipping industry on dangerous cargo transportation is the core of interest in this thesis.

Chapter 2: Transportation of Hazardous Cargoes

2.1 General Information

To begin with, dangerous goods can be defined as those with hazardous properties, and they may be deemed dangerous to human and animal health and safety, the environment, and infrastructure (Shipping and Freight Resource, 2016).

Such goods may be solid (e.g. coal, ammonia, and fertilizers), liquid (crude oil, sulfuric acid, solvents etc.) or gaseous (natural gas etc.), and they can be either raw materials or processed goods. As for their negative effects, they can be toxic to health and the environment, corrosive, flammable or explosive. Guidance on the safe transportation of dangerous goods, protection of crew and marine pollution prevention is given by International Maritime Dangerous Goods (IMDG) Code (see Appendix A for further details).

Figure 2.1 IMDG Code hazard labels

Source: Shippingandfreightresource.com

The IMDG Code in general aims to be an international guideline to the safe transportation or shipment of dangerous goods or hazardous materials by water on vessels. IMDG Code is intended to protect crew members and to prevent marine pollution in the safe transportation of hazardous materials by vessel. It is recommended to governments for adoption or for use as the basis for national regulations which are mandatory in conjunction with the obligations of the members of the United Nations under the International Convention for the Safety of Life at Sea (SOLAS) and the International Convention for the Prevention of Pollution from Ships (MARPOL 73/78). It is intended for use not only by mariners but also by all those involved in industries and services connected with shipping.

The Code contains advice on terminology, packaging, labeling, placarding, markings, stowage, segregation, handling, and emergency response, and divides all hazardous cargoes into 9 classes (and subclasses) according to their nature and properties. The current version of the Code is the 2016 Edition, which came into force on January 1st of 2018 for two years. The next version, the 2018 Edition, will come into force on January 1st of 2020, with the option of voluntary application on January 1st of 2019[1].

Each type of cargo has its own properties, transportation and storage requirements, and potential hazards to the environment, and each type requires different approaches and measures to avert or at least mitigate their environmental consequences.

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1. 'IMDG Code', International Maritime Organization http://www.imo.org/en/Publications/IMDGCode/Pages/Default.aspx, last viewed at 02/08/2019

2.2 Notable Examples of Hazardous Cargoes

2.2.1 Crude Oil and Products

Most of the world's crude oil is transported by sea via tanker vessels, which are preferred for long distances (where road trucks, rail and pipelines are not available or beneficial[2]) and carriages of large quantities. For crude oil, large "dirty" tankers up to 320,000 deadweight tons are used, while for petrol products, smaller "clean" tankers are more suitable. The larger the vessel, the lesser the cost of transportation per barrel becomes.

Figure 2.2 Typical Aframax crude oil tanker underway

Source: Sanoyas Japan

The main environmental issue that arises from oil transportation is oil spills, which can severely damage coastal environments and even coral reefs, and the restoration process requires a lot of time, effort and money. There are certain notable examples of such environmental disasters (*M/T Exxon Valdez*, see Chapter 2) that prove the need for safe cargo management. However, these incidents are rather small in number and they have been less common nowadays. Most oil spills are caused mainly at ports during loading/discharging operations (pipe leakages) (Transportation in Canada 2016).

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2. T. M., 'Oil Transport', Student Energy https://www.studentenergy.org/topics/ff-transport, last viewed at 03/08/2019

Many oil tankers today are equipped with double hulls and/or double bottoms, designed to prevent any cargo leakages even in case of hull breach due to grounding or collision. Apart from cargo oil, though, we should consider also the bunker fuel oil and petrol – based lubricants that all vessels carry and consume during their voyages. Most maritime accidents today, from an environmental perspective, involve fuel oils as well.

2.2.2 Chemicals (bulk and packaged)

Chemical products may be transported by sea either in bulk, or already packaged as "general cargo". According to IMO, carriage of chemicals in bulk is covered by regulations in SOLAS Chapter VII (Carriage of Dangerous Goods) and MARPOL Annex II (Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk). All modern chemical tankers are required to comply with the International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk (IBC Code).

Figure 2.3 Medium – sized chemical tanker (IMO Type II/III)

Source: MOL Chemical Tankers

Chemical tankers are generally divided by IMO into 3 categories:

- Type I: Tankers intended to transport products with very serious environmental and safety hazards requiring maximum preventive measures to prevent any leakage of cargo.

- Type II: Tankers intended to transport products with appreciably severe environmental and safety hazards requiring significant preventive measures to preclude an escape of such cargo.
- Type III: Tankers intended to transport products with sufficiently severe environmental and safety hazards to require a moderate degree of containment to increase survival capability in a damaged condition.

Most chemical tankers are IMO II and III rated, since the volume of IMO I cargoes is very limited.

In the case of packaged chemical products, they are either transported as "general cargo" (in appropriate chemical pallets) or in containers (the most common method). More specific, special containers may be used for chemical products. SOLAS Chapter VII provides rules for classification, packing, documentation and stowage of such dangerous goods. As a matter of fact, the combination of sealed containers and long journey times means that hazardous chemicals can build to a level that would never normally be encountered in domestic or industrial settings[3]. Around 15% of containers contain dangerous levels of chemicals, and port workers were unaware of the risks of chemical exposure in the past. Apart for the products themselves, the health and environmental risks come from the fumigants (used against vermin) as well, and they should be approved by experts. In general, packaged chemicals still pose a threat to the environment when they are lost due to a containership accident.

2.2.3 Dry bulk cargo

Dry bulk cargo generally represents over half of the total goods carried by sea, and major examples include iron ore, coal, grains and bauxite. Almost much like oil tankers, dry bulkers can cause pollution either accidentally (collision, hull breach, storm etc.) or by discharging cargo residues on purpose. Actually casualties involving bulk carriers are less covered by the media, compared to the tanker cases. Despite this, however, dry bulk cargo pollution is still considered important, and as amended by SOLAS Convention 1974 (Chapter VI), these issues are covered by the International Maritime Solid Bulk Cargoes Code (IMSBC Code). The Code aims to facilitate the safe stowage and shipment of solid bulk cargoes (excluding grains) by providing information on the dangers associated with the shipment of certain types of solid bulk cargoes and instructions on the procedures to be adopted when the shipment of solid bulk cargoes is contemplated.

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3. Widdowson, Caroline, 'Chemicals in containers – problems and risks', Port Technology https://www.porttechnology.org/technical-papers/chemicals_in_containers_problems_and_risks/, last viewed at 04/08/2019

As written earlier, bulk carriers may cause environmental pollution either accidentally or during their operations (loading, discharging and transshipment, dumping of residues and washing off cargo holds). Most accidents involving bulk carriers are caused because of inappropriate cargo distribution during loading the holds, leading to instability and damage to the vessel. Also some bulk cargoes may present spontaneous chemical reactions, such as coal liquefaction or combustion or acidic reaction that may contribute to further hazards against the ship, crew and environment. Although bulk carrier losses are more frequent than oil spills, they are usually not documented (Grote et al., 2016). Also most bulk cargoes may not be necessarily toxic, but in large quantities they may have adverse effects on natural habitats when released[4].

On the other hand, pollution may be occurred from cargo residues during loading/offloading operations, transshipment and cleaning of holds. When ships change cargoes, holds are rinsed to avoid possible cross-contamination of products. Rinse water may be discharged into offshore waters for nontoxic cargoes. However, accumulated cargo deposits may impact sensitive benthic habitats and result in sediment contamination (Stewart, Levy, & Walker, 2016). Cargo residues are mainly detected in port areas of main shipping routes, where loading/offloading operations are conducted, and even in mid – seas in case of transshipment.

Figure 2.4 Bulk carrier discharging limestone

Source: Marine Insight Photos

4. Walker, Tony R. et al., (2017) ‘Environmental Effects of Marine Transportation’ (Chapter 30), *World Seas: An Environmental Evaluation*, pages 9-10

Of all bulk cargoes, in general, coal may be considered the most hazardous because it is most susceptible to spontaneous combustion (due to insufficient ventilation). Also it is susceptible to unwanted chemical reactions. Notably, IMSBC Code requires that coal will not only be categorized as a chemical hazard cargo (Group B) but will also fall into Group A[5] (liquefaction).

2.2.4 Liquefied natural gas (LNG)

LNG can be considered as a “top trend” in the shipping market, since it is a type of fuel with low emissions when consumed and it is gradually used in a variety of applications (household and industrial use, electricity and transportation etc.) more often these years. Here, natural gas (which is mainly methane mixed with some amounts of ethane) takes liquid form in extremely low temperatures before it is ready to get safely stored in non – pressurized tanks or transported in specialized tanker vessels called LNG carriers.

Figure 2.5 Moss – type LNG carrier underway

Source: NYK Line

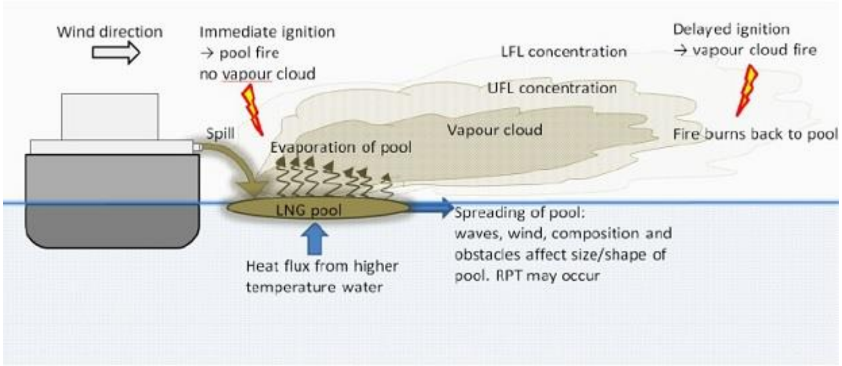
5. ‘New IMSBC requirements from Jan 2019’, SAFETY4SEA https://safety4sea.com/new-imsbc-code-requirements-from-jan-2019/, last viewed at 05/08/2019

There are 2 basic types of LNG carriers, depending on their cargo tank layout; carriers with usually separated, spherical external tanks (also known as the Moss – type) and membranous tank vessels (with special insulated containment steel tanks), which are the most recent and most technologically advanced carriers. All of these vessels have appropriately insulated tanks, with more than one barriers sometimes for the safe transportation of the cargo, although not perfect, because a small percentage is “boiled – off” (turn into gas again) each day during a voyage.

When a portion of the gas cargo is boiled – off, not only it may get lost, but also may be deemed dangerous (i.e. in case of an event of an event of instability). Therefore, that portion of gas should be contained, compressed and then used as an alternative fuel by the vessels (most LNG carriers have dual – fuel usage options for their engines), though the newest vessels are able to re – liquefy the boiled – off cargo.

Liquefied natural gas is indeed a dangerous cargo, because it is highly flammable and may explode in case of instability, such as heavy boil – off, cargo shift or leakage. Based on expert review, the most likely hazards to people and property would be thermal hazards from an LNG fire. Cryogenic and fire damage to an LNG ship were also identified as concerns that could cause additional damage to cargo tanks following an initial tank breach, though the additional impact on public safety would be limited[6].

Figure 2.6 Illustration of a possible outcome of an LNG spill



Possible outcome of LNG spill over water

Source: Liquefiedgascarrier.com

6. ‘Potential hazards of a large liquefied natural gas spill during marine transportation’, Liquefied Gas Carrier – Safety & operational matters http://www.liquefiedgascarrier.com/LNG-spill-risk.html

As soon as any leak or spill of LNG is exposed to ambient temperatures, the liquid will vaporize or boil – off. So the risk of inflammation is very high, while its density decreases as it gets warmer in the air. However, unlike other hydrocarbon gases, natural gas quickly becomes buoyant and, except in enclosed spaces, will rise and disperse rapidly as it warms. This dispersion is further aided by the very rapid diffusion properties of methane in air.

Fortunately, there are not any accidents or other harmful incidents involving LNG carriers, due to the safety of these vessels and strict regulations and standards. While issues about liquid gas spillage are still less covered by the media compared to oil spill cases, the LNG shipping sector is known so far to have a good safety record regarding cargo loss, and in most transport, loading – discharging operations, no loss or containment failure incidents have been identified (Pitblado, 2004).

2.3 Accidents and environmental issues

We already know that all hazardous cargoes have harmful properties to human life and health, property and the environment (including the ecosystem, flora and fauna). In shipping, transportation of dangerous goods has been unfortunately connected with many and severe accidents, some of which had devastating effects to certain ecosystems around the world and local communities, and had massive coverage by the media. The factors contributing to these cases were multiple and complex, although it is generally known that human errors are the main cause, and sometimes some technical failures. Depending on the cargo and the vessel, though, the probabilities for an accident and its environmental effects may vary (Mullai, 2006).

Oil tankers are known to have the biggest media coverage because of the number of oil spill incidents involving large tankers over the last decades. However, accidents with adverse environmental effects happen in the cases of other ship categories too, such as chemical tankers, containerships etc. Despite even all imposed rules about cargo handling and transportation, mistakes that could potentially lead to accidents still occur. We could also include the matter of fuel oil and lubricant spills that may occur in all types of ships. Therefore we have many parameters to consider about these accidents, and in the next chapter we will showcase some infamous accidents in order to get a better insight on the effects of dangerous cargoes to the environment and the importance of proper management for such cargoes.

Chapter 3: Notable environmental disasters

In this chapter we shall present three examples of severe maritime accident involving different kinds of hazardous cargoes, showcasing their history, probable causes, environmental consequences and measures which were given to respond to and mitigate each disaster, and will present the short – term and long – term outcomes of those disasters.

3.1 M/T *Exxon Valdez*

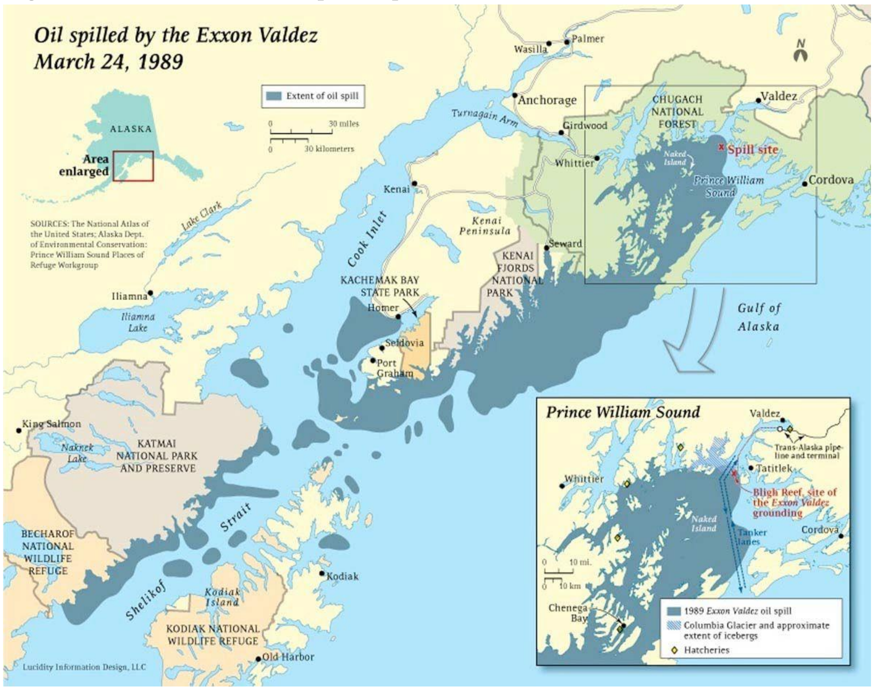
The oil spill caused by this tanker is considered one of the worst, if not the worst, maritime and environmental disasters of modern history.

Figure 3.1 *Exxon Valdez* at Prince William Sound in 1989

Source: Wikipedia

The tanker was a VLCC (very large crude carrier; 214,861 DWT, single – hull, built in 1986) owned by Exxon Shipping Company during the period of the accident, and she ran aground in the Prince William Sound region (Alaska, United States) on March 24th, 1989. She was bound for Long Beach, California, carrying 1,260,000 barrels of crude oil (53,100,000 US gallons; 201,000 cubic meters) until her hull hit Bligh Reef, 2.4 km (1.5 miles) west of Tatitlek, Alaska, at 12:04 a.m. The accident resulted in the spilling of about 120,000 barrels (10,800,000 US gallons; 41,000 cubic meters) of oil.

Figure 3.2 *Exxon Valdez* oil spill map



Source: Pinterest

The accident resulted in the pollution of 2,092 km (1,300 miles) of coastline, affecting the areas shown in the above map. Thousands of different species were killed, including 250,000 seabirds, an unspecified number of salmons and herrings, 2,800 sea otters, 300 harbor seals, 250 bald eagles and even at least 22 killer whales (estimated). The adverse effects on the whole ecosystem of the area were nearly devastating, both short – term and long – term, and scientific experts have noticed that oil toxic components (e.g. polycyclic aromatic hydrocarbons) have negative effects to the reproductive cycle of salmons and herrings, as they are toxic to their eggs (Marine Insight, 2019). Moreover, the oil itself affected the consistency of the sea water (hampering visibility of marine organisms) and even polluted the coastal environment at a significant scale. However, the accident heavily affected the local economy by devastating all fisheries of salmon, herring, crab and shrimp, while commercial fishing of salmon and herring had to be banned up until 1990. Also it devastated the tourism of the region, due to heavy pollution of the habitat, resulting in losses of billions of dollars and thousands of job positions.

Various factors apparently contributed to the *Exxon Valdez*, and they come from different involved stakeholders.

The tanker's captain, Joseph Hazelwood, was at her helm, and he attempted to alter her course to avoid icebergs. At 11:53 p.m., he gave the control of the ship to the 3rd mate to steer back to her original course. However, the ship's radar was actually broken (for more than a year, in fact), and then she collided with Bligh Reef on March 24, 12:04 a.m. It was strongly claimed that Cpt. Hazelwood was intoxicated after drinking and he fell asleep, and he took most of the blame for the accident, and the 3rd mate was possibly overwhelmed by fatigue or excessive overload, while she was sailing at night (reducing visibility). In fact, the ship's crew worked in 12 to 14 hour shifts plus overtime, and was the half number from the average crew for such a tanker (Leveson, 2005).

However, the facts tell us that Exxon Shipping Company neglected in certain factors that contributed to the accident. Firstly, the company did not take care for supervising the master and providing adequate rest hours to the crew, thus showing fatigue. Furthermore, Exxon failed to provide service and maintenance to the broken radar and to provide iceberg monitoring equipment as promised. The vessel travelled outside of the normal sea lane to avoid any thought – to – be icebergs, instead (Leveson, 2005).

On the other hand, the USCG (Coastguard) did not perform safety inspections on the vessel as required, and their staff was reduced by one – third. Also, the practices of ship tracking all the way out to Bligh reef had been discontinued, and tanker crews were not informed of this. As for the spill response & prevention teams and equipment, they were not readily available, and thus they were impaired to provide any help (Leveson, 2005).

Figure 3.3 Cleanup operations on *Valdez* – affected Alaskan shores

Source: Sciencesource.com

Large efforts were made for the cleanup of the accident site – or at least for the most affected areas. Most US agencies (Coastguard, EPA, NOAA), the local communities from Alaska, environmental organizations and even Exxon contributed to the cause with research, weather forecast, provision of cleanup equipment and treatment. In specific, lightering of not - spilled cargo, vessel salvage, booming of sensitive areas, beach surveys and assessments, over flights to track the floating oil, skimming of floating oil, cleanup of oiled beaches, wildlife rescue, waste management, logistics support and public relations were used. Major cleanup operations were conducted during the spring and summer of 1989-1992. Thousands of workers were involved in cleanup and logistics support operations that included hundreds of vessels, aircraft and a substantial land-based infrastructure[7]. More than 11,000 people were involved, and the operations had a cost of more than $ 2,000,000,000.

From 1989 to 1992, though, a rather small percentage of spilled oil was removed from seas and coasts initially, and according to a study by the National Marine Fisheries Service, NOAA in Juneau, by 2001 approximately 90 tons of oil remained on beaches in Prince William Sound in the sandy soil of the contaminated shoreline. Even until today the whole area has still to recover.

Exxon eventually had to pay billions of dollars for punitive damages as imposed by courts, make compensations to local communities, apart from contributing to the cleanup operation (Marine Insight, 2019). The ship's captain got fired from the company, and then he got convicted of misdemeanor negligence, paying a fine of $ 50,000 and serving 1,000 hours of community service. From a political aspect, the US Congress approved the formation of the Oil Spill Recovery Institute, and most importantly, passed the Oil Pollution Act (OPA) of 1990, which required the Coast Guard to strengthen its regulations on oil tank vessels and oil tank owners and operators (tankers are required to be double – hulled). Today, tank hulls provide better protection against spills resulting from a similar accident, and communications between vessel captains and vessel traffic centers have improved to make for safer sailing (Environmental Protection Agency). However, this was not the last oil tanker spill of our history.

3.2 M/V *Grande America*

A very recent maritime accident with adverse environmental effects was the one of the container & vehicle carrier *Grande America*, occurred in the French Atlantic seas.

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7. Shinnefield, Patrick 'Cleanup of the Exxon Valdez Oil Spill', https://web.stanford.edu/class/e297c/trade_environment/energy/hexxon.html

Figure 3.4 M/V *Grande America* burning on the Bay of Biscay

Source: Vesselfinder.com

Grande America was an Italian – flagged roll – on/roll – off/vehicle/container carrier built in 1997 (27,965 DWT), owned and operated by Grimaldi Lines. On 10 March 2019, while travelling from Hamburg, Germany to Casablanca, Morocco, she caught fire while sailing on the Bay of Biscay between France and Spain, one her fore part where the containers were carried. She was carrying at that time 2,210 vehicles (including dozens of Porsche and Audi cars, heavy trucks and buses) and 365 containers, 45 of which were listed containing hazardous materials (including 10 tons of hydrochloric acid and 70 tons of sulphuric acid, according to local maritime authorities[8]).

The ship started capsizing gradually after extensive fire damage, and she sank on March 12th in around 4,600 m (around 15,000 feet) of depth on the Bay of Biscay. However all 26 crewmembers and the one passenger on board were successfully rescued by the HMS *Argyll* of the British Royal Navy on March 11th and taken to Brest, Brittany.

The fire apparently started from a container loaded on the weather deck (because of some kind of cargo, according to Grimaldi Group), and spread to the rest of the containers, despite the efforts given by the crew, and had to abandon ship.

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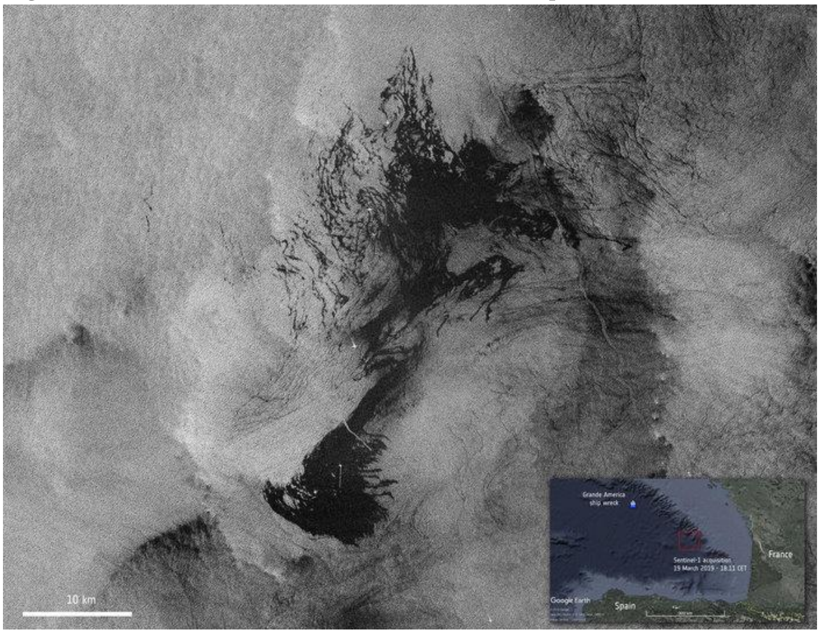
8. 'Grande America: France braces for oil spill damage after ship blaze', BBC News, https://www.bbc.com/news/world-europe-47574143, last viewed at 15/08/2019

Apart from the cargo, *Grande America* was also loaded with around 2,200 tons of heavy fuel oil, and the accident caused an oil slick with a length of around 10 km and a width of around 1 km. Thus the French authorities summoned some vessels to contain and reduce the pollution, and EMSA’s satellite monitoring systems (CleanSeaNet) were activated at the request of the French authorities. The operations of EMSA’s oil spill response vessels helped with the containment of the spill. The authorities were highly concerned about the pollution from the dangerous cargo containers; though it was assured that almost all of that cargo was ‘neutralized’ from the fire and that it was not likely to affect the sea. Later the authorities announced that the oil spill would not reach French or Spanish coast, although they warned that some containers and debris would reach the coasts quicker (Safety4Sea, 23 March 2019).

Figure 3.5 *Grande America* oil slick viewed from space



Source: ESA

On March 30th, the SPV *Island Pride* arrived at the Bay of Biscay to inspect the shipwreck through remote – operated underwater vehicles (ROV’s) and found some light leaks of oil, and got them sealed. It is worth to note that due to the accident, Porsche had to restart production of the last 4 911 GT2 RS that got lost (they went out of production in February 2019) to deliver them to their customers in Brazil.

As for Grimaldi Lines, it faced another fire incident on the car carrier *Grande Europa* on May 15th, and called for tighter cargo controls[9].

3.3 M/T *Stolt Valor*

Stolt Valor was a Hong Kong – flagged chemical tanker (25,269 DWT; built in 2003), operated by Fleet Management Ltd., Hong Kong and was time – chartered by Stolt Tankers. In September 15th, 2008, she was hijacked in the Gulf of Aden by Somali pirates who demanded initially a ransom of $ 6,000,000. After a series of long negotiations, the ship and the 22 crewmen got released on November 16th, paying $ 2,500,000 for ransom.

Figure 3.6 M/T *Stolt Valor* on fire

Source: Falck.com

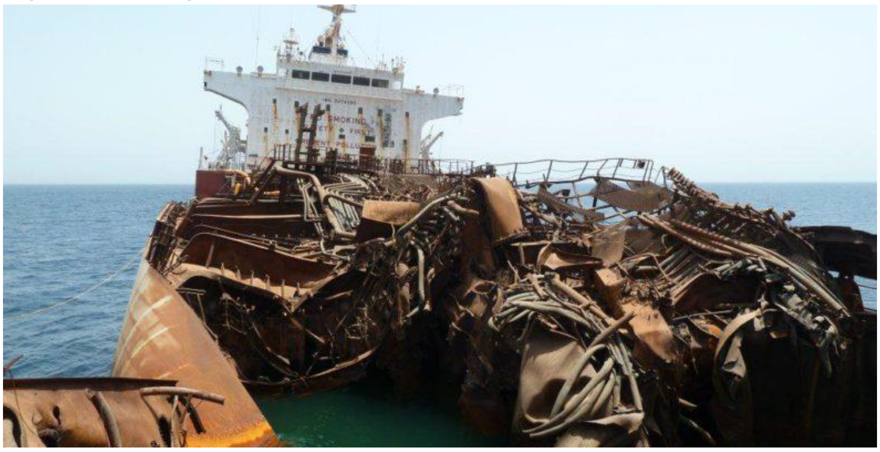
On March 15th, 2012, she suffered an explosion and caught fire 27 nautical miles (50 km) off Jubail, Saudi Arabia, while carrying a cargo of 13,000 tons of methyl tertiary butyl ether (MTBE) 1,300 tons of isobutyraldehyde (IBAL).

9. 'Grimaldi Group Calls for Tighter Cargo Controls After Fires', gCaptain https://gcaptain.com/grimaldi-group-addresses-grande-europa-fire/, last viewed at 17/08/2019

From the 25 crewmen serving that day, one was reported missing and later confirmed dead, whereas the rest were rescued by *USS John Paul Jones* of the US Navy and later transferred to *USCGC Baranof*. The fire was fully extinguished and all pollutants (both chemicals and the 430 tons of fuel oil) were contained (a large sum of the materials were already burnt out). A tug with oil spill response equipment was deployed in the accident site to contain the fuel spillage, with the nearby states providing additional assistance. In the following days, attempts to tow the vessel further away from the coast were made, until the towline broke in bad weather and the tanker drifted off Bahrain towards Qatar with the fire still raging. A towline was successfully re – established on March 19th a few nautical miles from the coast of Qatar and the casualty was eventually towed offshore[10].

On March 20th the fire was fully controlled and later salvors made an assessment of the vessel. It was found out that the middle tanks suffered extensive damage from the explosion, and apparently the cause was said to be unknown. Then, a larger issue appeared regarding the port of refuge to be chosen for the damaged tanker. The captain requested as such from the ports of four nearby countries; Qatar, Saudi Arabia, Bahrain and Iran, and all of the four refused. After long negotiations involving the owners, MEMAC (Marine Emergency Mutual Aid Center) and all state authorities, Saudi Arabia gave the permission to provide refuge to the tanker. After removing all hazardous cargoes, fuel oil and residues, *Stolt Valor* was deemed too heavily damaged to be repaired, because she would not be economically viable to continue operations. On October 2012, she was scrapped in Bahrain.

Figure 3.7 Damage of *Stolt Valor* after fire



Source: Soenen BVBA

10. ‘STOLT VALOR, off the Kingdom of Saudi Arabia, 2012’, ITOPF https://www.itopf.org/in-action/case-studies/case-study/stolt-valor-off-saudi-arabia-2012/, last viewed 20/08/2019

Chapter 4: The Framework of ISO 14000

4.1 General Introduction on ISO

The International Organization for Standardization (ISO) is an independent, non – governmental organization with the purpose of international standardization. ISO was founded on 23 February 1947, based in Geneva, Switzerland and operates in 164 countries (represented by their national standardization bodies) promoting worldwide proprietary, industrial and commercial standards. It is the world's largest developer of voluntary international standards that ensures high quality and safety in all production lines, as well as minimization of errors and waste. ISO has the mission of all product and service certification to safeguard their consumers and/or end – users and to ensure their conformity with the minimum international standards (ISO, 1997).

ISO standards apply in all sections of primary production (food, agriculture, fisheries, and raw materials), industry (manufacturing, construction, and transportation, including shipping. Most well – known ISO standards include the ISO 9000 family of standards on quality management systems (QMS), the ISO 14000 family (Environmental management systems, which will be our concern of analysis), the ISO 22000 standard on food safety management systems and the ISO 30000:2009 standard on ships and marine technology, ship recycling management systems and specifications for management systems for safe and environmentally sound ship recycling facilities.

ISO requires a series of stages for the development process of a standard. Further details can be found on Appendix B.

4.2 ISO 14000

The ISO 14000 family of standards, introduced in 1996, is a set of rules and standards with the aim to help organizations (e.g. industries) to: a) reduce the adverse effects of their operations (processes, manufacturing, etc.) to the environment; b) comply with all applicable laws, regulations, and other environmentally – oriented requirements; and c) continually improve in the above. ISO 14000 offers a framework for better environmental impact management, but it has an optional, "voluntary" basis for the companies to implement[11]. Moreover, ISO 14000 serves as an internal management tool apart from being a means of demonstrating environmental commitment to clients and the public.

11. Kenton, Will 'ISO 14000', Investopedia https://www.investopedia.com/terms/i/iso-14000.asp, last viewed 26/08/2019

This series of standards give companies the opportunity to sell products to companies that use ISO 14000 certified suppliers. Companies and customers may also pay more for products that are considered environmentally friendly. On the cost side, meeting the ISO 14000 standards can help reduce costs, as it encourages the efficient use of resources and limiting of waste. This may lead to finding ways to recycle products or new uses for previously disposed of byproducts. As a result, there is the benefit of ‘clean production’ with minimal costs (Arora et al., 2010).

ISO 14000 is very similar to ISO 9000 in terms of focusing to the process of producing a product, instead to the product itself. Also, the certification for ISO 14000 is rather given by a third – party organization, instead of ISO itself. This family of standards is developed by ISO’s Technical Committee ISO/TC 207.

The ISO 14000 series is comprised most notably from the ISO 14001 standard, which lays out the guidelines for putting an Environmental Management System (EMS) in place, and it represents the core of the whole series of standards (further information can be seen below) (ISO 14000 family, ISO). Then there is the ISO 14004, which gives additional guidelines for a good EMS, and more specialized standards dealing with specific aspects of environmental management. The ISO 14031 establishes the framework for an Environmental Performance Evaluation (EPE), used for measuring environmental impacts that can be controlled by organizations, and they can use it to measure, analyze, and assess their environmental performance against a set of criteria, and establish objectives and targets for improvements. The ISO 14040 – 14043 standards set the basis for Life Cycle Assessment (LCA) analysis, used for evaluating the environmental impacts along the entire chain of a product's life, and it includes the steps of goal and scope definition, inventory analysis, impact assessment and interpretation[12]. The following table provides the list of all standards that belong to the ISO 14000 family, along with their description.

12. Magerholm Fet, Annik (1998) *ISO 14000 as a Strategic Tool for Shipping and Shipbuilding*, pages 2 – 3

Table 4.1 List of ISO 14000 standards

Standard	Description
ISO 14000	EMS* - General Guidelines on Principles, Systems and Supporting Techniques
ISO 14001	EMS* - Specification with Guidance for Use
ISO 14004	EMS* - General Guidelines on Systems, Principles and Supporting Techniques
ISO 14010	EA** - General Principles of Environmental Auditing
ISO 14011	EA** - Auditing of Environmental Management Systems
ISO 14012	EA** - Qualification Criteria for Environmental Auditors
ISO 14013	Management of Environmental Audit Programs
ISO 14014	Initial Reviews
ISO 14015	Environmental Site Assessments
ISO 14020	EL*** - Basic Principles of Environmental Labeling
ISO 14021	EL*** - Self Declaration- Environmental Claims- Terms and Definitions
ISO 14022	EL*** - Symbols
ISO 14023	EL*** - Testing and Verification Methodologies
ISO 14024	EL*** - Practitioner Programs- Guiding Principles, Practices and Certification Procedures of Multiple Criteria (Type 1)
ISO 14031	Environmental Performance Evaluation
ISO 14040	LCA**** - General Principles and Practices
ISO 14041	LCA**** - Goal and Definition/Scope and Inventory Assessment
ISO 14042	LCA**** - Impact Assessment
ISO 14043	LCA**** - Improvement Assessment
ISO 14050	Terms and Definitions
ISO 14060	Guide for the Inclusion of Environmental Aspects in Product Standards

*EMS = Environmental Management Systems
**EA = Environmental auditing
***EL = Environmental Labeling
****LCA = Life Cycle Assessment

Source: Gdrc.org

An ‘ISO 14000’ certification can be achieved by having an accredited auditor verify that all the requirements are met, or a company may self-declare. Obtaining the ISO 14000 certification may also help companies meet certain environmental regulations.

4.2.1 ISO 14001:2015

ISO 14001, as written already above, is an internationally agreed standard that sets out the requirements for an Environmental Management System (EMS). It helps organizations improve their environmental performance through more efficient use of resources and reduction of waste, gaining a competitive advantage and the trust of stakeholders.

Using ISO 14001 can provide assurance to company management and employees as well as external stakeholders that environmental impact is being measured and improved, and it can also be integrated with other management functions, and assists companies in meeting their environmental and economic goals.

When we refer to an "environmental management system", we refer to 'a system and database which integrates procedures and processes for training of personnel, monitoring, summarizing, and reporting of specialized environmental performance information to internal and external stakeholders of a firm' (Sroufe, 2003). The requirements for such a system are set by ISO 14001, and the aim is that organizations must have an environmental protection framework to respond to changing environmental conditions in balance with socio – economic needs.

A systematic approach to environmental management can provide top management with information to build success over the long term and create options for contributing to sustainable development by[13]:

- protecting the environment by preventing or mitigating adverse environmental impacts;
- mitigating the potential adverse effect of environmental conditions on the organization;
- assisting the organization in the fulfillment of compliance obligations;
- enhancing environmental performance;
- controlling or influencing the way the organization's products and services are designed, manufactured, distributed, consumed and disposed by using a life cycle perspective that can prevent environmental impacts from being unintentionally shifted elsewhere within the life cycle;
- achieving financial and operational benefits that can result from implementing environmentally sound alternatives that strengthen the organization's market position;
- communicating environmental information to relevant interested parties.

13. 'ISO 14001:2015 (en), Environmental management systems – Requirements with guidance for use', ISO Online Browsing Platform (OBP) https://www.iso.org/obp/ui/#iso:std:iso:14001:ed-3:v1:en

Like the rest of ISO 14000 standards, ISO 14001 is voluntary. The organization can set its own targets and performance measures, and the standard highlights what an organization needs to do to meet those goals, and monitor and measure the situation. It can be applied from a variety of levels within the business, from the organizational to the product and service level. Apart from it, it sets the needs for the continuous improvement of the organization's systems, and provides a wider approach for environmental concerns. The standard has recently been revised, with key improvements such as the increased prominence of environmental management within the organization's strategic planning processes, greater input from leadership and a stronger commitment to proactive initiatives that boost environmental performance[14].

The current version of the standard is the ISO 14001:2015, which improves the earlier version according to the latest trends for environmental action, and focuses on the improvement of environmental performance rather than the improvement of the management system itself. Moreover, it includes several updates which help the environmental management to be more comprehensive and relevant to the supply chain, whereas organizations are asked to consider the environmental impact during the entire life cycle (although not required). The new standard also requires the holder of the certificate to specify risks and opportunities and how to address them.

The basic principles of ISO 14001 are based on the PDCA (Plan – Do – Check – Act) cycle. The "Plan" part in particular refers to the establishment of objectives and processes required to achieve environmental goal, targets and missions; "Do" is about the implementation of such processes (implementing the EMS within the organization as well as emergency preparedness and documentation) and "Check" refers to measuring and monitoring of processes and reporting results in respect to the organization's environmental objectives and targets, with the aid of internal audits. Finally, the "Act" part is about taking action for performance improvement of EMS based on the above results, through continuous improvement, renewal of existing plans or creation of new ones (Martin, 1998).

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14. *ISO 14001: Introduction to ISO 14001:2015* ISO Publications, International Organization for Standardization https://www.iso.org/files/live/sites/isoorg/files/archive/pdf/en/introduction_to_iso_14001.pdf

Figure 4.1 The PDCA cycle in regards of ISO 14001 and EMS

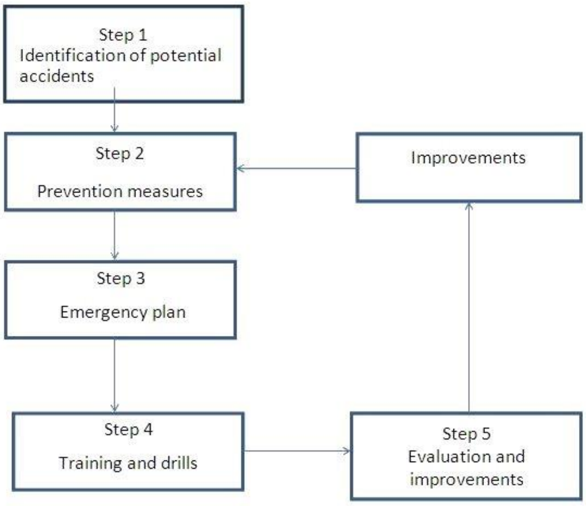
Source: ISO

The ISO 14001's 'Emergency Preparedness' refers to the handling evaluation of near accidents, as well as the prevention of similar accidents in the future. Environmental risks may occur from planned abnormal operations, which are already known by the organization, or from the unplanned accidents or near misses, which cannot be known in advance (Piper et al., 2003). In case of an environmental accident risk, the organization is required to have documented instructions for its avoidance. Moreover, if the accident has actually already occurred, the environmental impacts as well as the actions for the mitigation of the adverse effects need to be documented too. The assessment of all possible risks must be complete and analytical, taking all possibilities from the surrounding environment of the company. In addition, a supplementary requirement of ISO 14001 is that organizations should regularly update and modify their preparedness plans in case of new unexpected incident risks, document the routines to identify the causes of any particular accident, and take actions to avoid them in case they occur again. Companies can also conduct regular drills to simulate particular risks and take appropriate measures.

However, ISO 14001 does not indicate the level of how an environmental accident can be defined; the organization itself has the responsibility to define this[15].

15. Piper, Lennart et al., (2003) '4.3.7 Emergency preparedness', *Continual Improvement with ISO 14000*, page 170

Figure 4.2 Steps for an emergency preparedness plan



Source: Advisera.com

All in all, ISO 14001 has many advantages for organizations, but it has also some disadvantages. The advantages (both for the external and the internal environment of the organization) are the following[16]:

- ISO 14001 can help companies prove their commitment to environmental regulations given by the authorities, and improve relationships with them in the basis of 'good faith'.
- Companies can use this standard as a public relations 'instrument' to improve their image to citizens and environmental groups (this may be essential for organizations which suffer from heavy environmental pressures or a bad public image).
- Companies can develop a competitive advantage by using the ISO 14001, as required in a globalized market.
- Provides access to new markets with new and positive prospects (for instance, charterers and port authorities take the implementation of ISO 14001 from shipping companies into account more often).

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16. Papazafeiropoulos, Michail (2015) *Applicability of ISO 14001 in shipping – Developing policies and tactics* (academic thesis; translated from Greek), University of Piraeus, Department of Industrial Management and Technology

- The standard may provide a new proposal for a management method, by providing guidelines and strict rules on environmental management.
- It can be easily implemented, as it is complementary to ISM Code.
- It can provide incentives to employees to contribute to a common cause for the organization.
- The implementation of an EMS can help companies reduce their costs regarding environmental issues.
- Technological innovation can be achieved through environmental conformity (e.g. efficient ship designs, scrubbers, cleaner fuel, and new management practices).

The disadvantages of ISO 14001 are:

- The aim of the standard is to recommend environmental management practices rather than actually improve environmental performance of organizations; organizations themselves are responsible for optimal environmental practices. For example, two companies with similar business activities may both comply with ISO 14001 requirements, even if they differ in environmental performance.
- Bureaucratic procedures make the work of ISO 14001 more difficult, and it is believed that it 'deviates' the standard from monitoring of environmental performance.
- It is widely believed that the standard's principles may conflict with the principles and general orientation of the company's management, as it 'restricts' the employees in terms of decision making and responsibilities.

4.3 ISO 14000 in shipping and hazardous cargo transportation

The framework of ISO 14000 can be applied in all aspects of the shipping industry (shipbuilding, transportation) in regards of implementing environmental management systems, life cycle assessment and environmental performance evaluation, for instance. Companies nowadays are more than obliged to develop their environmental profile by achieving a sustainable life cycle of their shipping operations. In particular, the adverse environmental effects caused by hazardous cargo release (either by accident or during cargo handling or even intentional dumping/general average) must be reduced to the greatest possible level, and the tools of ISO 14000, along with international regulations and the history of previous relevant incidents can help to the aim of achieving a good environmental profile.

To begin with, all shipping companies today need to comply with the International Safety Management (ISM) Code, whose purpose is to provide an international standard for the safe management and operation of ships and pollution prevention. However it is not considered enough for competent environmental management. We could say that the ISO 14000 (ISO 14001, in particular) is complementary to ISM Code, since a shipping company may utilize ISO 14001 to further choose the best environmental measures for their vessels, and additionally develop an environmental management system, which can work together with the safety management system form ISM. We should indicate that both ISM Code and ISO 14001 are founded on a common set of general functional environmental management system elements[17]. The ISM requires the implementation of a safety & environmental protection policy at all organizational levels, and similarly IS0 14001 mandates preparation of an environmental policy, and that such policy be documented, implemented and maintained and communicated to all employees. What is more, companies can use the ISO 14001 standard in tandem with the already implemented ISO 9001, which is similar and they are also complementary to each other (see Appendix C).

Therefore, shipping companies have to use such systems and policies in order to avoid accidents or at least reduce environmental pollution involving hazardous cargoes. The same goes for the ship's regular operations, and the crew is obliged to comply with environmental management guidelines. We should additionally note that ISO 14000 requires the upgrade of the equipment of the vessels, as well as the appropriate training for seafarers (Panaitescu et al., 2015). Obviously, each vessel type has different needs for maritime environmental management, especially when different hazardous cargoes are involved. Oil and chemical tankers for example now are built with designs that ensure safe carriage of their cargo (e.g. double hulls or coated and insulated tanks), and strict instructions should be given for their management and operation.

The ISO 14000 series of standards is also involved with international regulations. For example, the International Convention for the Prevention of Pollution from Ships (MARPOL) has been in place many years ago, and it is applied worldwide; however it is not always followed in a uniform way. It is advisable for companies to review their practices and take additional steps to ensure compliance with environmental protection obligations, and fortunately ISO 14001 provides available detailed information about prudent environmental management for all companies who seek to satisfy global environmental needs.

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17. Thomas, William L. (1998) 'Achieving and Maximizing ISM Code Compliance with ISO 14001' *Environmental Quality Management*, page 13

Thus the combination of MARPOL regulation and ISO 14000 standards may be seen as a strong strategic chance for companies to form a 'clean' environmental profile, acquire recognition from authorities and reduce costs from claims, damages and compensation to third parties. In addition, the European Commission is also involved through its Eco-Management and Audit Scheme (EMAS), which is largely based upon the requirements of ISO 14001 (environmental reviews, audits, management systems, policies etc.). All organizations (public or private) are able to follow this scheme, and those that follow it automatically comply with the requirements of the ISO 14001 standard.

Environmental protection and management is also important to be applied in local (and sometimes enclosed) waters, according to national needs. It is worthwhile mentioning that in some national waters, such as Greece, where international regulations (e.g. IMO port environmental policies) are not wanted to be followed by the national authorities, the application of EMAS or ISO 14000 standards has actually drawn attention in prevention of port pollution (Alexopoulos, 2008).

In the end, we should point out that from a business perspective a shipping company tends to implement an environmental management standard like ISO 14001 when the industry itself sets environmental protection specifications. For example, organizations like Marine Environment Protection Committee (MEPC) promote good environmental practices and operational rules to advise their members. Furthermore, shipping companies are ought to follow environmentally friendly strategies to gain trust from charterers with a significant position on the market. A charterer will not cooperate with a company that is involved with a superficial number of accidents and pollution incidents, and will choose other, more environmentally responsible companies to cooperate with. Therefore a shipping company has to follow pro – environment practices to continue partnership with their clients and maintain a "lawful image". Lastly, shipping companies may have a competitive advantage if environmental benefits contribute to an increase of productivity[18]. Provided that its development plans and enterprise interests are not obstructed, the company will follow the ISO 14001 standard to strengthen its corporate relationships within the international trade, and increase profits in a long – term basis.

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18. Papazafeiropoulos, Michail (2015) 'Applicability of ISO 14001 in shipping – Developing policies and tactics (academic thesis; translated from Greek), University of Piraeus, Department of Industrial Management and Technology

Chapter 5: Conclusions

We can conclude that shipping itself faces many risks regarding effects to the environment, especially when transportation of dangerous goods is involved. These cargoes are considered harmful to human health, marine and coastal ecosystems, including all kinds of flora and fauna. This issue has been proven many times from the maritime accidents that have occurred over the past few decades. It is thus proven that environmental regulations are more than required to be imposed in order to reduce such incidents.

Shipping companies can use the ISO 14000 series of standards, along with the existing safety management codes and international regulations to achieve environmental conformity, and further develop environmental management systems for all levels of management, as well as the vessels' crews. Also the standards give instructions for improved designs and equipment for ships, for the safe transportation and handling of dangerous cargoes. More important, the standards of ISO 14000 can be used from companies as a means of public relations and networking in the shipping market, when earning trust from charterers, authorities, the media and other stakeholders. Therefore, sustainment through this type of standard is not only important to environmental protection, but it may give opportunities for greater profits and corporate development.

In the globalized sector of shipping, all regulations and standards are required both for safety management and protection of property and people, and protection of the natural environment. With the proper certifications and integrations follow by each company individually, it is more than sure that the shipping industry will become even more environmentally – friendly as the contribution of the stakeholders will bear fruits, despite all existing difficulties.

All in all, we should highlight once more the significance of this thesis for understanding the importance of shipping firm certification with ISO 14000 – 14001 for the conformity with the latest requirements for environmental management, protection, safety and cost reduction. The analysis on the most important cargoes and the history of the most infamous accidents further helped in understanding the above. The most important limitation on developing this theme was the partial scarcity of punctually relevant material for further analysis. However, with the given scientific and other sources we hope that this work will contribute to understanding the need for efforts of efficient ship management certified by ISO, with the least possible adverse effects to the environment and minimal operational costs, effectively giving the companies a strong profile in the shipping market.

Bibliography

<u>Books, articles and other publications</u>

- Papazafeiropoulos, Michail (2015) *Applicability of ISO 14001 in shipping – Developing policies and tactics* (academic thesis; translated from Greek), University of Piraeus, Department of Industrial Management and Technology
- Alexopoulos, Aristotelis B. (2008) *Managing and Assessing Oil Spills Through Systematic Methods*, University of the Aegean, Department of Marine Sciences, Lesvos, Greece
- Arora, Pooja, Chaudry, Smita (2010) *ISO 14000 – its structure and benefits*, Institute of Environmental Studies, Kurukshetra University, Kurukshetra
- Charlier, Roger H. (1999) *Hazardous Goods and their Environmental Impact*, Free University of Brussels (VUB) (Belgium)
- *Friendship Among Equals – Recollections from ISO's first fifty years* (1997), International Organization for Standardization
- Grote, Matthias, Mazurek, Nicole, Gräbsch, Carolin, Zeilinger, Jana, Le Floch, Stéphane, Wahrendorf, Dierk – Steffen, Höfer, Thomas (2016) 'Dry bulk cargo shipping – An overlooked threat to the marine environment?', *Marine Pollution Bulletin*, Elsevier
- *ISO 14001: Introduction to ISO 14001:2015*, ISO Publications, International Organization for Standardization
- *ISO 14001 – Key Benefits*, ISO Publications, International Organization for Standardization
- Magerholm Fet, Annik (1998) *ISO 14000 as a Strategic Tool for Shipping and Shipbuilding*
- Martin, Raymond (Dr) (1998) *ISO 14001 Guidance Manual*, NCEDR, University of Tennessee
- Melnyk, Steven A., Sroufe, Robert P., Calantone, Roger (2003) 'Assessing the impact of environmental management systems on corporate and environmental performance', *Journal of Operations Management*, Elsevier
- Mullai, Arben (2006) *Maritime Transport and Risks of Packaged Dangerous Goods*,
- Panaitescu, Fanel – Viorel, Panaitescu, Mariana (2015) *An approach to the implementation of ISO 14000 at a shipping company*, Constanta Maritime University, Faculty of Naval Electro – Mechanics, Romania
- Piper, Lennart, Ryding, Sven – Olaf, Henricson, Curt (2003) *Continual Improvement with ISO 14000*, IOS Press
- Pitblado, R M, Baik, J, Hughes, G J, Ferro, C, Shaw, S J (2004) *Consequences of LNG Marine Incidents*, CCPS Conference Orlando

- *Transportation in Canada 2016 – Comprehensive Report*, Government of Canada
- Walker, Tony R., Adebambo, Olubukola, Del Aguila Feijoo, Monica C., Elhaimer, Elias Hossain, Tahazzud, Johnston Edwards, Stuart, Morrison, Courtney E., Romo, Jessica, Sharma, Nameeta, Taylor, Stephanie, Zomorodi, Sanam (2018) 'Environmental Effects of Marine Transportation' (Chapter 30), *World Seas: An Environmental Evaluation*, Dalhousie University, Halifax, NS, Canada

Websites

- Chemical tanker, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/Chemical_tanker
- 'Compare ISO 9001 to ISO 14001', Integrated Standards https://integrated-standards.com/compare-management-system-structure/compare-iso-9001-iso-14001/
- 'EMSA contingency plan for emergencies activated in response to the Grande America accident', EMSA – European Maritime Safety Agency http://www.emsa.europa.eu/news-a-press-centre/external-news/item/3482-grande-america.html
- Exxon Valdez oil spill, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/Exxon_Valdez_oil_spill
- 'Exxon Valdez Spill Profile', US EPA https://www.epa.gov/emergency-response/exxon-valdez-spill-profile
- Grande America, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/Grande_America
- 'Grande America: France braces for oil spill damage after ship blaze', BBC News, https://www.bbc.com/news/world-europe-47574143
- 'Grande America transported 1.050 tonnes of dangerous goods' SAFETY4SEA https://safety4sea.com/grande-america-was-transporting-1-050-tonnes-of-dangerous-goods/
- 'Grimaldi Group Calls for Tighter Cargo Controls After Fires', gCaptain https://gcaptain.com/grimaldi-group-addresses-grande-europa-fire/
- 'IMDG Code', International Maritime Organization http://www.imo.org/en/Publications/IMDGCode/Pages/Default.aspx
- International Maritime Dangerous Goods Code, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/International_Maritime_Dangerous_Goods_Code

- International Organization for Standardization, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/International_Organization_for_Standardization
- ‘ISO 14000 family – Environmental management’, International Organization for Standardization https://www.iso.org/iso-14001-environmental-management.html
- ‘ISO 14001:2015 (en), ‘Environmental management systems – Requirements with guidance for use’, ISO Online Browsing Platform (OBP) https://www.iso.org/obp/ui/#iso:std:iso:14001:ed-3:v1:en
- ISO – International Organization for Standardization https://www.iso.org
- Kenton, Will ‘ISO 14000’, Investopedia https://www.investopedia.com/terms/i/iso-14000.asp
- LNG carrier, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/LNG_carrier
- Mambra, Shamseer ‘The Complete Story of the Exxon Valdez Oil Spill’ https://www.marineinsight.com/maritime-history/the-complete-story-of-the-exxon-valdez-oil-spill/
- Muckian, David ‘Hazardous Cargo Freight and Global Transport’, Shipping and Freight Resource https://shippingandfreightresource.com/hazardous-cargo-freight-and-global-transport/
- MT *Stolt Valor*, Wikipedia, the free encyclopedia https://en.wikipedia.org/wiki/MT_Stolt_Valor
- ‘New IMSBC requirements from Jan 2019’, SAFETY4SEA https://safety4sea.com/new-imsbc-code-requirements-from-jan-2019/
- ‘Potential hazards of a large liquefied natural gas spill during marine transportation’, Liquefied Gas Carrier – Safety & operational matters http://www.liquefiedgascarrier.com/LNG-spill-risk.html
- Shinnefield, Patrick ‘Cleanup of the Exxon Valdez Oil Spill’, https://web.stanford.edu/class/e297c/trade_environment/energy/hexxon.html
- ‘STOLT VALOR, off the Kingdom of Saudi Arabia, 2012’, ITOPF https://www.itopf.org/in-action/case-studies/case-study/stolt-valor-off-saudi-arabia-2012/
- T. M., ‘Oil Transport’, Student Energy https://www.studentenergy.org/topics/ff-transportWiddowson, Caroline,
- ‘Chemicals in containers – problems and risks’, Port Technology https://www.porttechnology.org/technical-pape

Appendix A: International Maritime Dangerous Goods (IMDG) Code

Contents

Part 6: Construction and Testing of Packages, IBC's, Portable Tanks, MECG's and Road Tank Vehicles

Part 7: Provision Concerning Transport Operations

Volume 2

Part 3

- 3.1 General
- 3.2 Dangerous goods list
- 3.3 Special provisions applicable to certain substances, materials or articles
- 3.4 Dangerous goods packed in limited quantities
- 3.5 Dangerous goods packed in excepted quantities

Appendix A: List of generic and N.O.S. proper shipping terms

Appendix B: Glossary of terms

Information contained in the Dangerous goods list

- UIN number
- Proper shipping name
- Class or division
- Subsidiary risks
- Special provisions
- Limited and excepted quantity provisions
- Packing
- IBC
- Portable tanks and bulk containers
- EMS
- Stowage and handling
- Segregation
- Properties and observations

Appendix B: Table of ISO's International Harmonized Stage Codes

Stage	**Substage**		
	00 Registration	**20 Start of main action**	**60 Completion of main action**
00 Preliminary	**00.00** Proposal for new project recieived	**00.20** Proposal for new project under review	**00.60** Close of review
10 Proposal	**10.00** Proposal for new project registered	**10.20** New project ballot initiated	**10.60** Close of voting
20 Preparatory	**20.00** New project registered in TC/SC work programme	study initiated	**20.60** Close of comment period
30 Committee	**30.00** Committee draft (CD) registered	**30.20** CD study/ballot initiated	**30.60** Close of voting/ comment period
40 Enquiry	**40.00** Draft International Standard (DIS) registered	**40.20** DIS ballot initiated: 12 weeks	**40.60** Close of voting
50 Approval	**50.00** Final text received or FDIS registered for formal approval	**50.20** Proof sent to secretariat or FDIS ballot initiated: 8 weeks	**50.60** Close of voting. Proof returned by secretariat
60 Publication	**60.00** International Standard under publication		**60.60** International Standard published
90 Review		**90.20** International Standard under periodical review	**90.60** Close of review
95 Withdrawal		**95.20** Withdrawal ballot initiated	**95.60** Close of voting

90 Decision			
92 Repeat an earlier phase	**93 Repeat current phase**	**98 Abandon**	**99 Proceed**
		00.98 Proposal for new project abandoned	**00.99** Approval to ballot proposal for new project
10.92 Proposal returned to submitter for further definition		**10.98** New project rejected	**10.99** New project approved
		20.98 Project deleted	**20.99** WD approved for registration as CD
30.92 CD referred back to Working Group		**30.98** Project deleted	**30.99** CD approved for registration as DIS
40.92 Full report circulated: DIS referred back to TC or SC	**40.93** Full report circulated: decision for new DIS ballot	**40.98** Project deleted	**40.99** Full report circulated: DIS approved for registration as FDIS
50.92 FDIS or proof referred back to TC or SC		**50.98** Project deleted	**50.99** FDIS or proof approved for publication
90.92 International Standard to be revised	**90.93** International Standard confirmed		**90.99** Withdrawal of International Standard proposed by TC or SC
95.92 Decision not to withdraw International Standard			**95.99** Withdrawal of International Standard

TC: Technical Committee, FDIS: Final Draft International Standard

Source: ISO

Appendix C: Table of comparison between ISO 14001:2015 and ISO 9001:2015

ISO 9001:2015	ISO 14001:2015
0.1. General	**0.1.** Background
0.2. Quality management principles	**0.2.** Aim of an environmental management system
0.3. Process approach	**0.3.** Success factors
0.3.1. General	**0.4.** Plan-Do-Check-Act model
0.3.2. Plan-Do-Check-Act cycle	**0.5.** Contents of this international standard
0.3.3. Risk-based thinking	
0.4. Relationship with other management standards	
1. Scope	**1. Scope**
2. Normative references	**2. Normative references**
3. Terms and definitions	**3. Terms and definitions**
4. Context of the organization	**4. Context of the organization**
4.1. Understanding the organization and its context	**4.1.** Understanding the organization and its context
4.2. Understanding the needs and expectations of interested parties	**4.2.** Understanding the needs and expectations of interested parties
4.3. Determining the scope of the quality management system	**4.3.** Determining the scope of the environmental management system
4.4. Quality management system and its processes	**4.4.** Environmental management system
4.4.1. ..Establish, implement, maintain and continually improve..	
4.4.2. ..Maintain documented information..	
5. Leadership	**5. Leadership**
5.1. Leadership and commitment	**5.1.** Leadership and commitment
5.1.1. General	
5.1.2. Customer focus	
5.2. Policy	**5.2.** Environmental policy
5.2.1. Establishing the quality policy	
5.2.2. Communicating the quality policy	
5.3. Organizational roles, responsibilities and authorities	**5.3.** Organizational roles, responsibilities and authorities
6. Planning	**6. Planning**
6.1. Actions to address risks and opportunities	**6.1.** Actions to address risks and opportunities
6.1.1. ..Consider issues of 4.1 and requirements of 4.2..	6.1.1. General
6.1.2. ..Actions to address risks and opportunities	6.1.2. Environmental aspects
	6.1.3. Compliance obligations
	6.1.4. Planning action
6.2. Quality objectives and planning to achieve them	**6.2.** Environmental objectives and planning to achieve them
6.2.1. ..Quality objectives at relevant functions..	6.2.1. Environmental objectives
6.2.2. ..Determine what, who, when, how..	6.2.2. Planning actions to achieve environmental objectives
6.3. Planning of changes	
7. Support	**7. Support**
7.1. Resources	**7.1.** Resources
7.1.1. General	
7.1.2. People	
7.1.3. Infrastructure	
7.1.4. Environment for the operation of processes	
7.1.5. Monitoring and measuring resources	* 9.1.1. Operational control – Monitoring, measuring equipment
7.1.5.1. General	
7.1.5.2. Measurement traceability	
7.1.6. Organizational knowledge	
7.2. Competence	**7.2.** Competence
7.3. Awareness	**7.3.** Awareness
7.4. Communication	**7.4.** Communication
	7.4.1. General
	7.4.2. Internal communication
	7.4.3. External communication

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7.5. Documented information	**7.5.** Documented information
7.5.1. General	7.5.1. General
7.5.2. Creating and updating	7.5.2. Creating and updating
7.5.3. Control of documented information	7.5.3. Control of documented information
7.5.3.1. ..Documented information controlled..	
7.5.3.2. ..Activities for control of information..	
8. Operation	**8. Operation**
8.1. Operational planning and control	**8.1.** Operational planning and control
8.2. Requirements for products and services	**8.2.** Emergency preparedness and response
8.2.1. Customer communication	
8.2.2. Determining the requirements for products and services	
8.2.3. Review of the requirements for products and services	
8.2.3.1. ..Ensure ability to meet requirements..	
8.2.3.2. ..Retain documented information..	
8.2.4. Changes to requirements for products and services	
8.3. Design and development of products and services	***8.1.** Operational control – Design and development
8.3.1. General	
8.3.2. Design and development planning	
8.3.3. Design and development inputs	
8.3.4. Design and development controls	
8.3.5. Design and development outputs	
8.3.6. Design and development changes	
8.4. Control of externally provided processes, products and services	***8.1.** Operational control- External providers
8.4.1. General	
8.4.2. Type and extent of control	
8.4.3. Information for external providers	
8.5. Production and service provision	
8.5.1. Control of production and service provision	***8.1.** Operational control-Provision of production and service
8.5.2. Identification and traceability	
8.5.3. Property belonging to customers or external providers	
8.5.4. Preservation	
8.5.5. Post-delivery activities	***8.1.** Operational control – Delivery and post delivery
8.5.6. Control of changes	
8.6. Release of products and services	
8.7. Control of nonconforming outputs	
9. Performance evaluation	**9. Performance evaluation**
9.1. Monitoring measurement, analysis and evaluation	**9.1.** Monitoring measurement, analysis and evaluation
9.1.1. General	9.1.1. General
9.1.2. Customer satisfaction	
9.1.3. Analysis and evaluation	9.1.2. Evaluation of compliance
9.2. Internal audit	**9.2.** Internal audit
9.2.1. ..Conduct internal audits at planned intervals..	9.2.1. General
9.2.2. ..Plan, establish, implement and maintain audit program..	9.2.2. Internal audit program
9.3. Management review	**9.3.** Management review
9.3.1. General	
9.3.2. Management review inputs	
9.3.3. Management review outputs	
10. Improvement	**10. Improvement**
10.1. General	**10.1.** General
10.2. Nonconformity and corrective action	**10.2.** Nonconformity and corrective action
10.2.1. ..When a nonconformity occurs..	
10.2.2. ..Retain documented information..	
10.3. Continual improvement	**10.3.** Continual improvement

Source: Integrated – standards.com