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OIL SPILLS AND SAFETY LEGISLATION

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ABSTRACT

Since 19th century when the first oil tankers started to operate there have been many major oil tanker accidents which have caused public outcry and political pressure to develop maritime safety legislation. The Torrey Canyon (1967) accident was the first major oil accident that had an impact on international regulation and after it MARPOL 73/78 was adopted. The Amoco Cadiz (1978) accident was the world's largest oil tanker accident causing the developing of the first regional port state control Paris MoU. The Exxon Valdez (1989) accident caused the most expensive oil accident and after that OPA 90 was adopted in the USA. The Erika (1999) and the Prestige (2002) accidents had a great impact on EU legislation. The Propontis (2007) accident reminded us the importance of preventing oil accidents in the Baltic Sea.

Although lots of improvements have been done on the safety since the early days of oil transportation there are still lots of things to do. The most important factor in preventing oil spill accidents is adopting the safety culture part of global maritime transportation.

TIIVISTELMÄ

Maailman ensimmäiset öljytankkerit aloittivat öljyn kuljetuksen 1800-luvulla. Sen jälkeen maailmalla on tapahtunut useita suuria öljyonnettomuuksia, jotka ovat aiheuttaneet voimakasta julkista paheksuntaa ja saaneet aikaan poliittisen paineen kehittää meriturvallisuuteen liittyvää lainsäädäntöä. Torrey Canyonin (1967) onnettomuus oli ensimmäinen öljyonnettomuus, jolla oli vaikutusta kansainväliseen lainsäädäntöön. Onnettomuuden seurauksena hyväksyttiin MARPOL 73/78. Amoco Cadizin (1978) onnettomuus oli maailman suurin öljyonnettomuus. Sen seurauksena kehitettiin ensimmäinen alueellinen satamavaltioiden tarkastusjärjestelmä Paris MoU. Exxon Valdezin (1989) onnettomuus aiheutti maailman kalleimman öljyonnettomuuden, ja onnettomuuden seurauksena USA:ssa hyväksyttiin OPA 90. Erikan (1999) ja Prestigen (2002) onnettomuuksilla oli suuri vaikutus EU:n lainsäädäntöön. Propontiksen (2007) onnettomuus muistutti öljyonnettomuuksien ehkäisemisen tärkeydestä erityisesti Itämerellä.

Vaikka öljykuljetusten turvallisuuden suhteen on tapahtunut paljon parannusta, vielä on paljon parannettavaa. Tärkein tekijä öljyonnettomuuksien ehkäisyssä on turvallisuuskulttuurin omaksuminen osaksi maailmanlaajuista meriliikennettä.

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1. INTRODUCTION

Every year 1 800 million tons of crude oil, is transported by sea in the world (Hänninen & Rytkönen 2004). Marine transport is one of the safest transport ways and usually oil is transported safely to its destination. Nowadays there are big oil spills of 700 tons or more an average four a year (Gwin 2009). However, there is always a risk of an enormous oil spill.

In the past there have been big oil tanker accidents resulting in large quantities of oil spills that have led to major public attention and to an attempt to find ways to minimize the risks related to such events. Often large oil spill accidents are associated with collision, grounding or with loss of structural integrity. Some of the accidents have caused big financial loss and local damages to the environment. These accidents have had influence on the development in maritime standards and safety legislation. In recent years some of the best-known oil spill accidents in the world are Exxon Valdez (1989), Erika (1999) and Prestige (2002). (Vanem et al.2008.) Typically amendments of legislation are taken after major disasters and preventive actions are still uncommon. When convention has been adopted it will usually take two to five years until it enters into force. (Knapp & Franses 2009.)

This paper concentrates on some of the best-known oil spill accidents and the rules, standards and regulations that have been updated as a direct response to these accidents. In this paper it is tried to find out what impacts new safety legislation and standards have had on minimizing the risks related to oil tanker accidents. Five different oil spill accidents have been chosen: Torrey Canyon (1967), Amoco Cadiz (1978), Exxon Valdez (1989), Erika (1999) and Prestige (2002). Also one incident without oil spill has been chosen: Propontis (2007). The Torrey Canyon oil spill was the first major oil tanker disaster that had a great influence on international regulation. The Amoco Cadiz was the world's largest oil spill incident ever. The Exxon Valdez incident happened in Arctic environment and it has been estimated to bee the most expensive oil spill. The Erika and the Prestige oil spills happened in Europe and therefore they had a great impact on EU legislation. Although grounding of the Propontis tanker in the Baltic Sea did not cause an oil spill it is here to show how environmental disaster was only just avoided in the ecologically vulnerable Baltic Sea. This paper also presents a historical review how preventing actions relating in oil spills and oil accidents have changed and developed during the decades.

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The Centre for Maritime Studies is a special unit of the University of Turku and it is one

of the leading providers of education, research and expert services in the maritime field in Finland. In addition to its national activities, the CMS has taken part in numerous international projects especially in the area of the Baltic Sea. The Kotka office of the Centre for Maritime Studies functions as a part of Kotka Maritime Research Centre. The KMRC has existed since 2005 and research units from four universities operate in its premises: the University of Helsinki, Helsinki University of Technology, the University of Turku and Kymenlaakso University of Applied Sciences.

2. OILPOL 1954

The first oil tankers in the whole world started to operate in the late 19th century. The standard size of the tankers stayed rather small, 16 400 dwt, until the 1950s. After that the size of the tankers grew fast and in 1959 the first 100 000 tons oil tanker was delivered. While the oil transportation increased the awareness of the potential for oil to pollute marine environment increased too. (IMO 2009b.)

In the beginning of the 20th century oil pollution of the seas was started to be recognized as a problem. In a consequence in 1954, International Convention for the Prevention of Pollution of the Sea by Oil (OILPOL) was adopted. OILPOL was the first international convention which aim was to protect the marine environment from pollution by oil tankers. It established zones near land in which the discharge of oil containing more than 100 parts of oil per million was forbidden. It also required promoting the provision of facilities for the reception of oily water and residues. At that time the focus was still on polluting resulting from routine operations and the discharge of oily wastes, not on oil spill accidents caused by oil tankers. However, the growth in oil trade showed that the 1954 OILPOL was not adequate and new actions were required. (IMO 2009a.)

3. TORREY CANYON AND MARPOL

3.1 The Torrey Canyon Accident

Oil accident of the tanker Torrey Canyon happened in England on March 1967. The captain of the Torrey Canyon realized that they were east of the intended course. He wanted to save some time and decided to go through the gap between the Schillies and Seven Stones reef. Unfortunately there was a plotting error and after that the autopilot was disengaged. Consequently the ship ran aground at the Scilly Isles off Lands End in England. (Devanney 2006.) It spilled about 119 000 tons of crude oil, killing thousands of birds and threatening the livelihoods of local people (ITOPF 2009b). It caused massive pollution of beaches in France and England (Denenberg 1970) and it was the worst oil accident at that time (Scanlon 2001).

The Torrey Canyon accident demonstrated the dangers of tanker spills (Scanlon 2001). It was the first major oil tanker disaster that got general public attention and in response to that the international Conventions were finally triggered (ITOPF 2009b). In 1969 the owners of the Torrey Canyon agreed to a settlement of 7 200 000 dollars (Denenberg 1970). The accident proved that there was a need to establish a system that would ensure the payment of compensation. In 1969 the International Convention on Civil Liability for Oil Pollution Damage (CLC) was adopted and it ensured that compensation was paid to victims and the liability was placed on ship owner. It also set the maximum liability. Because everyone was not pleased to the established liability limits, in 1971 International Fund for Compensation for Oil Pollution Damage was adopted. The Fund is made up of contributions from oil importers. (IMO 2009d.) "If an accident at sea results in pollution damage which exceeds the compensation available under the Civil Liability Convention, the Fund will be available to pay an additional amount, while the burden of compensation will be spread more evenly between ship owner and cargo interest" (IMO 2009d).

The Torrey Canyon oil spill can be seen as the turning point in international action on oil spills (Scanlon 2001). For example IMO expanded its activities in the environmental and legal fields (IMO 1998). It established rules that let government to act if an accident threatens its coastline in international waters (Scanlon 2001). The accident of the Torrey Canyon warned the whole world about the dangers of a major oil spill (Devanney 2006).

3.2 MARPOL 73/78

3.2.1 Convention 1973

The Torrey Canyon oil spill raised questions how to prevent oil pollution and revealed that the system for providing compensation following accidents at sea was deficient. To prepare an international agreement for placing restraints on the contamination by ships IMO convened an international conference. Despite the great Torrey Canyon oil spill the Conference still considered that operational pollution was bigger threat than

accidental oil pollution. In 1973 the International Convention for the Prevention of Pollution from Ships was adopted and it incorporated much of OILPOL 1954 into Annex I, covering oil. (IMO2009a.) Annex I improved OILPOL 1954. For example it determined requirements for constant monitoring of oily water discharge and required that governments had to provide reception facilities for oily wastewater. (IMO 1998.) Other Annexes covered chemicals (Annex II) and harmful goods in packaged from, sewage and garbage (Annexes III, IV and V). (IMO 2009a.)

The 1973 Convention defines the conditions when the operational discharges of oil from tankers are allowed. The Convention requires to keep an oil diary where is recorded for example the movement of cargo and its residues. In addition oil-carrying ships are required to have appropriate equipments as oil-discharge monitoring system, slop tanks, pumping arrangement etcetera. New tankers of 70 000 dwt or above have to have segregated ballast tanks and they have to meet damage stability requirements. (IMO 2009a.) Governments have to provide treatment facilities at oil terminals and ports (IMO 1998). The 1973 Convention defines special areas which are so vulnerable that oil discharges within them is prohibited, only with minor exceptions. Special areas in the 1973 Convention were the Mediterranean Sea, the Baltic Sea, the Black Sea, the Red Sea and the Gulfs area. (IMO 2009a.) Now the Gulf of Aden area, the Antarctic area and North West European waters are also defined as special areas (IMO 2006).

Unfortunately some states had technical problems relating in Annex II and therefore they did not ratify the Convention. Because of that by 1976 only three states had ratified the Convention. The requirement was 15 states so it started to look like the 1973 Convention would never enter into force. (IMO2009a.)

3.2.2 Protocol 1978

In 1976−1977 happened many tanker accidents (IMO 2009a) like Argo Merchant in U.S in 1976 (Knapp & Frances 2009), Urquiola in Spain in 1976 and Hawaiian Patriot near Honolulu in 1977 (ITOPF 2007). In response to that IMO held a Conference on Tanker Safety and Pollution Prevention in 1978 and the conference adopted measures affecting tanker design and operation. The measures were incorporated into the Protocol of 1978 relating to the 1974 SOLAS Protocol and relating to the 1973 MARPOL Protocol. The 1978 International Convention for the Prevention of Pollution from Ships (MARPOL) Protocol allowed states to become Party to the Convention by implementing Annex I. Annex II would become binding not until three years after the Protocol entered into force. (IMO2009a.)

The 1978 Protocol required crude oil washing system and segregated ballast tanks on all new tankers of 20 000 dwt and above (IMO2009a; IMO 1998). The new convention required segregated ballast tanks so it was no longer possible to use the same volume for ballast and cargo (Devanney 2006). Therefore, tanker designers started to do taller tanks and according to Devanney (2006) the size of the tanks grew which increases spillage if tank is broken. This led to very serious consequences: In 1989 the Exxon Valdez spilled approximately 10 million liters more oil than if she had been pre-Marpol

ship (Devanney 2006). According to Devanney (2006), a single-hull Marpol tanker spills two times more oil as a good single-hull pre-Marpol tanker. According to the 1978 MARPOL Protocol the segregated ballast tanks should protect the cargo and so they should be positioned where the impact of grounding is greatest. Ballast tanks are empty or loaded only with water ballast for the return leg. Thus the amount of cargo spilled after an accident decreases when the ballast tanks are positioned this way. (IMO 2009c.) "The rule is that 30% of the side shell in way of the tanks had to be non-cargo" (Devanney 2006).

1978 Protocol absorbed the 1973 Convention (IMO 2009a). "International Convention for the prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto" (IMO 2006) known as MARPOL 73/78 is then a combination of two treaties adopted in 1973 and 1978 (IMO 2009a). It entered into force in 1983 (for Annexes I and II). MARPOL73/78 covers prevention of pollution of the marine environment by ships and it contains the most important regulations for preventing pollution by oil from ships. (IMO2009a.) Its main aim is to prevent pollution from ships caused due to an accident or normal operations (Knapp & Franses 2009). Nowadays the Convention includes six different technical Annexes which are:

"Annex I Regulations for the Prevention of Pollution by Oil
Annex II Regulations for the Control of Pollution by Noxious Liquid Substances in Bulk
Annex III Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form
Annex IV Prevention of Pollution by Sewage from Ships
Annex V Prevention of Pollution by Garbage from Ships
Annex VI Prevention of Air Pollution from Ships" (IMO 2009a.)

Since the adoption of MARPOL 73/78, Convention has been amended several times. The most important amendments have been made in response to the Exxon Valdez (1989) oil spill, the Erika (1999) oil spill and the Prestige (2002) oil spill (Knapp & Franses 2009.)

The Exxon Valdez oil spill in 1989 caused one of the most important changes that have been made to the Convention (IMO 1998). In 1990 amendments it was required introduction of the harmonized system of survey and certification, and the Antarctic was designated as a special area (IMO 2006). In 1991 amendments it was required that ship must carry an oil pollution emergency plan (IMO 1998). In 1992 the first double-hull requirement was adopted but the phase-out of single-hull tankers was accelerated after the Erika oil spill. Accelerated phase-out entered into force in 2003. (See chapter 6.1) (IMO 2009a.)

Knapp and Franses (2009) have measured the effectiveness of international conventions by using econometric models. They have developed a method to measure the effect of IMO and ILO conventions in the area of safety, pollution, search and rescue and work related measures. Knapp and Franses (2009) have used standard econometric models. Their dataset is based on 50 367 casualties in 1977−2004 and their analysis is based on

45 milestones of the legislative framework. They have linked conventions to casualty areas and tried to filter out the effect of the convention. According to Knapp and Franses (2009) the MARPOL models demonstrate that the different amendments in relation with the phase-out of single-hull tankers decreased the number of casualties with pollution and even the amount of pollution to a certain degree.

According to IMO (1998) MARPOL is seen "as the most important set of international regulations for the prevention of marine pollution by ships". However, the problem of the IMO convention is that they are not always effective. The reason for this is that some countries do not have the experience, resources and expertise to make the convention part of their national law. (Scanlon 2001.) IMO has not enforcement power (Devanney 2006) and therefore states had to ratify the IMO conventions before they entry into force (Scanlon 2001). "The effectiveness of international conventions depends upon the degree to which they are obeyed and this depends largely upon the extent to which they are enforced" (IMO 2009a).

Flag states are seen as first factors to eliminate substandard vessels (Knapp & Franses 2007b). Unfortunately different Flag states have different standards to enforce the conforming of conventions. For example some Flag States do not demand conforming of the international safety standards and therefore Flag State inspection is problematic. These states are known as flags of shame. (Karvonen et al. 2006.) For example, the tankers Prestige and Erika which suffered structural failures (Devanney 2006) and broke in two, were both registered in countries with minimal ship safety standards (See chapter 6) (WWF 2003).

4. AMOCO CADIZ AND PARIS MOU

4.1 The Amoco Cadiz Accident

On 16 March 1978 hydraulic steering gear of the Amoco Cadiz failed in heavy weather (Devanney 2006) and despite the towing attempts the tanker grounded off the coast of Brittany in France (CEDRE 2008a). Many tanks were broken and the entire cargo even 227 000 tons of oil, was spilled into the water (CEDRE 2008a). Oil contaminated over 300 km of the Brittany coastline and killed 20 000 birds, millions of molluscs and other benthic species, and affected seriously oyster cultivation, fishery, and tourism (ITOPF 2009c). According to scientists even 260 000 tons of marine animals were killed (CEDRE 2008b).

Rough seas prevented effective offshore recovery operation. Different ways to remove the oil were used like dispersants, skimmers, and vacuum trucks. (ITOPF 2009c.) The accident was the largest oil tanker spill in the whole world (CEDRE 2008a) and it caused the largest loss of marine life caused by an oil spill at that time (ITOPF 2009c). The French State, local government and individual victims took legal action against the ship owner, Amoco Transport Company, and they claimed over 152 million Euros (1978 value). Finally 14 years after the accident, in 1992, the court reassessed the damages and decided that the total compensation for all damages was nearly 192 million Euros (1992 value). (CEDRE 2008b.)

The accident caused many changes especially in France. Important series of measures were set up in France to reduce the risks of new accidents and to ensure response resources. New marine pollution response plan was established and a traffic separation scheme ascertained that vessels carrying hazardous materials cannot sail closer than 50 km from the coast. According to this, high sea tug was placed to assist vessels and a specialist technical centre (CEDRE) was created to assure technical surveillance. (CEDRE 2008b.) The Torrey Canyon (1967) and the Amoco Caditz (1978) spills made the first series of conventions aimed at environmental protection (Ornitz & Champ 2002). The Amoco Cadiz accident caused public outcry also in other parts of Europe and this led to the establishment of Paris Memorandum of Understanding on Port State Control (Paris MoU 2009b) which is discussed in the next chapter.

Now over 30 years after the accident, there are still some imbalances but only among a few benthic populations in the most badly affected bays. All economic activities like tourism and fishing industry have recovered. And all the worst fears of long term effects including reproductive reduction and cancer in animals have been proved to be gratuitous. Nowadays the accident is part of history. (CEDRE 2008b.)

4.2 Paris Memorandum of Understanding on Port State Control

The Amoco Cadiz oil spill caused a political and public concern in Europe and stringent regulations were demanded. In response to that in 1982 the Paris Memorandum of Understanding on Port State Control was created and 14 European countries signed it.

(Paris MoU 2009b.) The signatories promised to inspect 25 % of the foreign ships visiting ports and they decided to develop inspection standards (Devanney 2006). Paris MoU is a regional port state control system and it was the first one in the whole world (Schiferli 2007). It covered safety of life at sea, prevention of pollution by ships and living and working conditions on board ships (Paris MoU 2009b). The mission of the Paris MoU is to eliminate the shipping of sub-standard vessels (Paris MoU 2009a). It is done by targeting vessels for inspections, carrying the inspections out and detaining substandard vessels (Sage 2005).

Nowadays "the Paris MoU covers the waters of the European coastal States and the North Atlantic basin from North America to Europe" (Paris MoU 2009a). At present 27 maritime Administrations are members of the Paris MoU (Paris MoU 2009a). Paris MoU has been amended many times to accommodate new safety and marine environment requirements (Paris MoU 2009b). Since 1982 the International Labour Organization (ILO) and the International Maritime Organization have participated in the Paris MoU meetings and since 2006 the Paris MoU has had the status at the IMO as an Inter Governmental Organization (Paris MoU 2007). Paris MoU has relationship with many international regulators like International Maritime Organisation (IMO), International Labour Organisation (ILO), the European Commission and the European Maritime Safety Agency (EMSA) (Hogan 2007).

The Paris MoU has a system, to rank ships and to determine which ships have to be inspected (Knapp & Franses 2007a). At the beginning the selection of ships was done by the inspector based on visual observation (Schiferli 2007). Nowadays there is a target factor to help to identify the ships for inspection. The target factor is calculated by using generic factor and history factor. "The generic factor rates the risks attached to the ship's flag, the ship type and age combined, classification with no a non-EU society, age above 12 years old, non-ratification of all main conventions by the flag State and a class deficiency ratio above average". (Sage 2005.) The history factor takes into consideration results of inspections carried out under Paris MoU, like number of deficiencies (Sage 2005).

The inspection begins so that the inspectors check the certificates that the ships have to carry and then inspectors carry out either detailed or expanded inspection (Sage 2005). Following the Erika and the Prestige accidents, EU has required that high-risk ships have to have an expanded inspection every 12 months. This requirement has been incorporated into the Paris Memorandum of Understanding on Port State Control so it applies all States of the Paris MoU. Oil tankers over 15 years old and over 3000 GT are considered as high risk ships. (Paris MoU 2009d.) When a State notices a high-risk vessel along its coast, it can provide advice to the ship's master when needed and position emergency towing vessels (Sage 2005). If the ship is unsafe to sail it is detained and if the ship has very serious deficiencies it will be detained until the deficiencies have been rectified (Paris MoU 2009c). If a ship has been detained the owner or the operator of the ship will have to pay all costs accrued by the port state to inspect the ship and the detention will not be lifted until payment or sufficient guarantee (Paris MoU 2009c). There has been increased demand for tonnage world wide and difficulties of ship owners to find qualified seafarers. Because of that, after five years of

declining detention rates, the number of detention rates has increased in port state control inspections within the Paris MoU region in 2006 and 2007. (Paris MoU 2007.)

In 2007 there were found one or more deficiencies in 56.4 % of inspections and the average amount of deficiencies per inspection were 3.27. The number of deficiencies has increased but so has the number of inspections too. New inspection regime in 2011 will demand that low-risk ships have to be rewarded with a 24 to 36 month inspection interval and high-risk ships with an inspection every 6 month. The European Maritime Safety Agency (EMSA) has promised to develop a database for the Paris MoU to manage the new inspection regime. (Paris MoU 2007.)

Every year Paris MoU establishes Black-Grey-White lists of quality flags and flags with poor performance. The performance is calculated by the Paris MoU on the basis of inspected and detained ships over a three year rolling period flying the considered flag. These black listed flags are one of the criteria for targeting vessels for inspections. (Degré 2008.) In 2007 there were 19 flags on the ”Black List” which was more than in 2006. The last ones in that list were Korea DPR, Bolivia and Albania in 2007. (Paris MoU 2007.) All tankers that fly a black listed flag and have been detained two times in two years are denied to access to ports in Paris MoU region (Sage 2005).

The problem of the port state control is that Port State Control regimes do not recognize the inspections that are performed in another regime. This leads to an impairment of targeting vessels for inspections and causes a high level of inspections. Too many various inspections increase the working hours of crew and may offset the positive impact of the inspection. To improve the current system, IMO is promoting harmonization of port state control inspections at a global level. **(**Knapp & Franses 2007c.) Knapp and Franses (2008) studied differentiate effects of various ship safety inspections. Their study shows that detention does not seem to be significant factor to decrease the probability of casualty. Knapp and Franses (2008) recommend that a direct policy implication would be to “revise the procedures of a ship from the release of detention and to share data amongst regimes “. There is a lack of rectification of deficiencies because the data is not shared amongst Ports State Control regimes. If the data is shared, the rectification of the deficiencies can be increased and if inspection data from several sources is combined it can improve vessel risk profiling and allocate inspection results more efficiently. (Knapp & Franses 2008.) Knapp & Franses (2008) recommend promoting the harmonization of inspection databases, increasing cooperation amongst regimes and reviewing the policy of release of a vessel from detention.

Knapp and Franses (2007b) studied 183 819 port state control inspections from various Port State Control regimes and casualties from different data sources in period 1999−2004. According to that study approximately 43% of the vessels eligible for inspection represent a group where inspections decrease the probability of casualty but at the same time almost 7 % of the vessels represent a group of over-inspected vessels. More than 13 % of the vessels belong to a group where inspections, targeting or both could be improved. So the targeting can be improved and it can be achieved by shifting the emphasis from over-inspected vessels to under-inspected vessels and by developing

a Global database. The probability of casualty and especially the probability of very serious casualties decrease when the number of inspections increases. Port state control inspection can decrease the probability of a very serious casualty by 5% per inspection. This demonstrates that port state control is effective. (Knapp & Franses 2007b.)

The market affects to the probability of casualties. In the research made by Knapp and Franses (2007c) based on the period 1999 to 2004, it was showed that when the earnings increase it has a negative effect on the probability of casualties in shipping. So, when the shipping market is good, more money can be spent on safety. (Knapp & Franses 2007c.)

Also according to Payoyo (1994) Paris MoU has been successful in eliminating substandard vessels. It has identified the quantitative and qualitative extent of substandardness in the region which has helped to develop strategies to address the problem of substandard vessels. It has also enforced international maritime standards by given feedback to the IMO about implementation of relevant instruments. The Paris MoU has showed that regional cooperation will allow for the efficient use of resources and it has allowed the MoU states to cooperate successfully. (Payoyo 1994.)

It is widely recognized that regional regimes of port state control are powerful and nine regional MoUs have been established since Paris MoU (Paris MoU 2007). The optimism is mainly result of the European experience under Paris MoU (Payoyo 1994). Paris MoU has worked together with other MoUs (Schiferli 2007) and assisted them (Paris MoU 2007). Unfortunately some of the flag states that belong to regional MoUs are on the Paris MoU's "Black List" (Paris MoU 2007). Therefore the effectiveness of them can be questioned.

According to Devanney (2006) the main problems with port state control of tankers are that inspectors do not go in the tanks. Therefore serious deficiencies may not be noticed. The other problem is that port state efforts have not any impact on tanker design and construction. To reduce the tanker spillage these things have to be rectified. (Devanney 2006.) The Paris MoU was signed already 27 years ago but there are still unsafe vessels endangering the environment. Therefore the members of Paris MoU will continue to fight against sub-standard shipping (Paris MoU 2007).

5. EXXON VALDEZ AND OPA 90

5.1 The Exxon Valdez Accident

On 24 March 1989 the single-hulled oil tanker Exxon Valdez ran aground at Bligh Reef in Prince William Sound in Alaska when it was sailing out of the shipping lanes trying to avoid meeting with icebergs (WWF 2009a). The tanker spilled approximately 38 800 tons of crude oil into the water (Gwin 2009). Oil contaminated 1 900 km of shoreline and killed mammals and hundreds of thousands of seabirds (NYT 2007). In 1989 over 11 000 workers 1 400 vessels and 85 aircraft were employed to clean up the damage (Cleveland 2008). There were lots of problems with the oil combatting operations: only a few pieces of equipment were in the area in a timely manner (EVOSTC 2009), Alyeska spill response barge was not in use and some boom was incorrectly used and damaged because of inexperienced workers (Cleveland 2008). The captain was accused as alcohol consumption, insufficient supervision of the crew, automatic pilot engaged too soon and dangerous attempts to leave the place where the accident happened (CEDRE 2007). The Exxon Valdez did have an oil spill crisis plan but it was not used because it was considered to be too expensive (Goldberg & Harzog 1996). The accident was a coincidence of many deficiencies and mistakes but five main causes of the accident have been determined to be:

"1. The third mate failed to properly maneuver the vessel, possibly due to fatigue and excessive workload.
2. The master failed to provide a proper navigation watch, possibly due to impairment from alcohol.
3. Exxon Shipping Company failed to supervise the master and provide a rested and sufficient crew for the *Exxon Valdez*.
4. The U.S. Coast Guard failed to provide an effective vessel traffic system.
5. Effective pilot and escort services were lacking." (Cleveland 2008.)

The Exxon Valdez became the vessel responsible for the largest oil spill in the U.S (CEDRE 2007). Because the accident happened in Arctic wilderness area with important fisheries the response operation was the most expensive in oil spill history and it caught the attention of media (ITOPF 2009a). Recreational sport fishing losses were estimated to be between 3.6 million dollars to 50.5 million dollars (Cleveland 2008). Economists calculated that the public valued a pristine Prince William Sound to be 4.9 to 7.2 billion dollars and that amount reflects the public willingness to pay to prevent another hazard oil accident (Cleveland 2008).

Exxon Corporation was fined 150 million dollars but the court forgave 125 million dollars in recognition of cooperation in cleaning up. Exxon Corporation paid also 100 million dollars for the injuries caused to animals and environment and paid 900 million dollars annually until 2001 for restoration of the ecosystem. To oversee this restoration the Exxon Valdez Oil Spill Trustee Council was formed. (EVOSTC 2009.)

20 years after the accident, oil is still found on Prince William Sound beaches and intertidal zones (WWF 2009a). According to Trustee Council, oil find in the

environment is almost as toxic as it was just a few weeks after the accident. Because of the structure and composition of the beaches, cold temperature, lack of waves and winter storm in the Gulf of Alaska, oil has persisted and remained toxic in Prince William Sound. As the Exxon Valdez accident taught risk assessment must consider what the total damages will be and not only the acute damages after the accident. (EVOSTC 2009.) This accident enforces the U.S. and other countries to implement stricter standards for cargo vessels (Gwin 2009).

The Exxon Valdez oil spill showed that the spill prevention and response capability was inadequate in Prince William Sound. Consequently many improvements in oil spill prevention and response planning has been made. Every tanker in Prince William Sound has to be double-hulled by year 2015. When tankers are passing through the sound two escorts vessels accompany them and they are capable of assisting them in the case of an emergency. During the voyage through the sound, there are specially-trained marine pilots aboard the ship. The U.S Coast Guard monitors tankers as long as they exit the sound. The combined ability of skimming systems to remove oil from the water is ten times greater than in 1980, there is ten times more containment boom than in 1989 when the Exxon Valdez ran aground, and drills are held every year. (EVOSTC 2009.) Dispersants are stockpiled and they are in place to apply them for example from helicopters and there are seven barges where the oil-water-mix can be recovered (Cleveland 2008). According to EVOSTC (2009) now twenty years after the Exxon Valdez oil spill the ability of industry and government to respond is much stronger but it is still unsure if a spill the size of the Exxon Valdez oil spill can be removed once it is on the sea.

5.2 Oil Pollution Act of 1990

After the Exxon Valdez oil spill it was concluded that the spill could have been prevented and that the response was inadequate. People were concerned for environmental disaster like this happening again. Consequently of political pressures and public concern, the US Congress passed a comprehensive act, the Oil Pollution Act of 1990 (OPA 90). This is a good example of how oil spills and public concern after an oil spill can lead to a policy change. Without the Exxon Valdez oil spill, this new trigger policy change would not have happened so fast. (Birkland & Lawrence 2002.) The impact of the Exxon Valdez oil spill on regulation is shown in Table 5.1.

The aim of OPA 90 was to reduce the number and the volume of the oil spills and minimize the damage to natural resources (Ketkar 1995). Intent was to minimize oil spills through improved tanker design and greater preparedness (COPA 1998). OPA 90 defines that ship owners or operators are responsible for the cost of pollution incidents (Stopford 2008) and not just for the clean-up but for damage to the natural resources too (Ornitz & Champ 2002). To prove that ship has sufficient means to pay the claim, every ship must carry a certificate of financial responsibility (Stopford 2008). Normally the owner will respond to the spill and his insurance will fund the response but if the owner does not initiate a response or cannot fund it or the spill is of unknown origin Oil Spill Liability Trust Fund provides Federal resources (OCIMF 2003). OPA 90 consolidated

three small spill cleanup funds into one greater fund, Oil Spill Liability Trust Fund (Birkland & Lawrence 2002). The Oil Spill Liability Trust Fund minimizes the damages to natural recourses by providing efficient and quick cleanup (WWF 2009a).

In the study based on period 1976−2004 both non-operational measures (like increased liability) and operational measures (like the phase-out schedule of single-hull vessels) related to OPA 90 were effective in reducing oil spills (Homan & Steiner 2008). Since the OPA 90 was signed the volume of oil spilled from tankers into the U.S waters has decreased 95 % (Knapp & Franses 2009). OPA 90 established double-hull requirements for newly constructed tankers and tank barges sailing in U.S waters and a phase-out schedule for the single-hull tankers by 2015 (Knapp & Franses 2009). It also required developing detailed contingency oil spill response plans, for the areas where oil is extracted, stored or transported and it required stockpiling of dispersants (WWF 2009a). OPA 90 established operational requirements for single-hull tankers including bridge resource management training, minimum rest for watch-keeping personnel, enhanced vessel surveys and minimum under keel clearance requirements (OCIMF 2003). At present many of these operational requirements have been embedded into international law like SOLAS, MARPOL and STCW (OCIMF 2003) and the new phase-out time for single-hull oil tankers is by year 2010 (Knapp & Franses 2009). OPA 90 had an impact on the international community which required the phase-out of single-hull tankers (Homan & Steiner 2008).

The idea of OPA 90 is that everything possible should be done to prevent oil spills but when an oil spill occurs, there should be an adequate and appropriate response. OPA 90 focused on five areas: Prevention, Preparedness, Response, Liability and Compensation as well as Research and Development. Prevention focuses on crew competence and double-hulls. Preparedness includes Contingency Plans, Vessel Response Plans and Exercises, requirements for training and qualifications of Qualified Individuals and personnel in Oil Spill Response Organizations. Response means that the Coast Guard is responsible for ensuring a safe and effective response to all oil spills in marine environment. Liability and compensation means that OPA 90 provides a liability and compensation regime. It serves as a deterrent to pollution to those that might potentially spill the oil and it provides funds for clean-up and compensation for rogue spill. Research and development includes response and prevention techniques and hardware. These five areas are important to an effective oil spill prevention program. (OCIMF 2003.)

According to OCIMF (2003) the main reasons for the success of OPA 90 are that “it provides a comprehensive legislative package that addresses all of the issues and it is rigorously and consistently enforced”. The US Cost Guard is responsible for implementing the provisions of OPA 90 and it uses inducements and sanctions to engender compliance. The sanctions have had the most important deterrent effect on potential polluters. (OCIMF 2003.) OPA 90 shows us that it is possible to learn from tanker accidents and use that knowledge to prevent new accidents (Birkland & Lawrence 2002). The Exxon Valdez and other oil spills in the U.S have affected on the public opinion of oil spills and oil spills are not anymore considered as an unavoidable accident of environmental conditions (Ornitz & Champ 2002).

Although lots of things have changed after the Exxon Valdes oil spill, the risk of oil spill will always exist. According to WWF (2009a) only little has changed in how it is responded to oil spills in the Arctic. Because mainly the oil response technology is tested in temperate climates there is not enough experience of deploying spill response equipment in the Arctic. Therefore it is hard to predict how they will operate in extreme weather conditions. (WWF 2009a.) WWF (2009a) writes that despite the requirements outlined in the OPA 90 there are still no better resources for oil combatting operation in bad weather conditions.

Table 5.1. The changes of regulation (OPA 90) after the Exxon Valdez accident

Ship structure	Shipping operations	Liability	Oil spill prevention and response
• double-hulls	• escort vessels accompany tankers in Prince William Sound • operational requirements for single-hull tankers	• responsible for the cost of pollution incidents (clean-up and compensation) • Oil Spill Liability Trust Fund	• Oil spill response plan • Stockpiling of dispersants • U.S Coast Guard monitoring tankers in Prince William Sound • Specially-trained marine pilots aboard

6. ERIKA AND PRESTIGE

6.1 The Erika Accident

On December 1999 the 25-year-old oil tanker Erika ran aground and broke into two near the coast of Brittany in France (Brans 2000). There was stormy weather at that time and the tanker had deficiencies in its maintenance. All this caused the accident. The tanker was registered in Malta. (OSIR 2008.) It spilled 20 000 tons of oil into the sea polluting 400 km of the France coast (EC 2002). The spill had environmental and economic consequences impacting negatively on fishing and tourism (Brans 2000). It was determined that inadequate repair and maintenance resulting corrosion, extreme sea conditions and the errors the ship's captain made in handling the vessel caused the accident (OSIR 2008). It has been estimated that the damages cost 840 million Euros (Urrutia 2006).

The ship's owner and manager were fined 75 000 Euros, the classification company RINA was fined 375 000 Euros, and Total SA Company that owned the fuel oil the Erika was carrying was ordered to pay 375 000 Euros (OSIR 2008). Classification Company RINA had fully approved the Erika although later it was proved that it has serious deficiencies (Devanney 2006). Classification societies take payments for their services and contend for customers. This is one example that shows the problems in this system. Total SA was convicted because it had shown carelessness by not taking into account the age and the condition of the ship while chartering the Erika. They all were also ordered to pay total damages of 192 million Euros. Court of France had never before awarded damages for harming the environment. (OSIR 2008.)

In 1990 the Erika was converted to segregated ballast tanks because that was required under the 1992 MARPOL amendments. However, the amendments did not require that the tanks should be coated. Coating is very expensive so the Erika was not coated although all segregated ballast tanks are coated when built because of the high corrosion rates. (Devanney 2006.) According to Devanney (2006) the Erika oil spill was caused by the combination of uncoated segregated ballast tanks and criminally lax inspection by the ship's Classification Society. According to him new regulation should have outlawed uncoated ballast tanks and implemented a non-owner controlled hull inspection regime.

After the Erika oil spill an accelerated phase-out schedule for single-hulled tankers was included in MARPOL (OSIR 2008). According to the 2003 amendment all single-hull oil tankers have to be phased-out by 2010 (Knapp & Franses 2009). IMO started to adopt additional measures dealing with spill compensation and other measures which would minimize the risk of oil pollution (OSIR 2008). IMO adopted new amendments under the International Convention on Civil Liability for Oil Pollution Damage (CLC Convention) and the International Convention on the Establishment of an International Fund for Compensation for Oil Pollution Damage (IOPC Fund) in 2000 (IMO 2009c). The amendments rose "by 50 % the limits of compensation payable to victims of pollution by oil from oil tankers" (IMO 2009c). The Erika oil accident exceeded the earlier compensation limits under CLC 1992 (Faure & Hui 2003).

Also the EU has considerably improved maritime safety since the Erika oil spill (EC 2002). The Erika oil spill revealed serious gaps in the maritime safety rules (EC2002) and showed the need to harmonize European maritime rules (Young 2003.) Therefore Erika I and II packages were adopted. They put effecting rules to increase maritime safety and to counter the risks of oil spills. (EC 2002.) The main content of the Erika I and II packages is shown in Table 6.1.

6.2 Erika Packages

The Erika I package strengthened the existing Directive on Port State Control. Each year over 4 000 vessels are subject to mandatory structural inspections and ships that are often found in a bad condition are banned from entering EU ports. (EC 2002.) Every 6 months the "Black list" of banned ships is published (Urrutia 2006). The Erika I also strengthened the Directive governing the activities of classification societies that check the structural quality of ships. The performance of the classification societies is strictly monitored and if they cannot meet the standards there are temporary or permanent withdrawal to operate on behalf of EU Member States. The Erika I accelerated the worldwide process of phasing-out of single-hull oil tankers. (EC 2002.) After the Prestige oil disaster the phasing-out of single-hull tankers accelerated again in EU (EEA 2003) and by 2010 the last single-hull tankers will be banned from EU waters (EC 2002).

The Erika II provides solutions to promote the Erika I (EC 2002) and improvements to models concerning liability and compensation (Young 2003). The Commission proposed establishing a special Compensation Fund for Oil Pollution in European Waters (COPE fund). The COPE fund will compensate victims of oil spills and the maximum limit is 1000 million Euros. This regulation has not yet been adopted. (EU 2007.) The Erika II sets new basis of an EU-wide vessel traffic monitoring and information system (Urrutia 2006). The system improves the identification and monitoring of ships, allows the member states to make an intervention if there is a threat of pollution accident off their coast and forbids ships from leaving ports in very bad weather conditions (EU 2007). The Erika II started also the establishment of the European Maritime Safety Agency (EMSA) (Urrutia 2006). The Erika and the Prestige oil accidents caused the decision to set up a new EU body to act as the technical and operational arm of EU decision makers. In 2003 EMSA was established. (EMSA 2009.) EMSA's aim is to reduce the risk of maritime accidents, marine pollution from ships and the loss of human life at sea. EMSA is active in strengthening the port state control regime, auditing Community-recognized classification societies, the development of a common methodology for the investigation of maritime accidents and establishment of a Community vessel traffic monitoring and information system. (SAI, BMT, CMS 2006.)

Table 6.1. Erika I and Erika II packages.

Erika I	**Erika II**
• strengthened port state control in EU ports • stricter monitoring of classification societies • phase-out of single-hull oil tankers by 2010	• establishment of EMSA • new basis of a vessel traffic monitoring and information system • the COPE fund

In 2009 the European Parliament adopted the "Third package of legislative measures on maritime safety in European Union" called Erika III package (OSIR 2009). Despite the name, the Commission wants to avoid the linkage between the Erika III and the Erika accident (Karvonen et al. 2006). Erika III consists of eight regulations and directives and the new rules mandate (OSIR 2009):

"Permanent blacklisting of dangerous ships and tougher and more frequent inspections; Stricter insurance requirements for ship owners and better compensation to passengers in the event of accidents; Mandatory compliance with international safety standards for ships flying a Member State flag; and an independent authority in each Member State with the power to launch rescue operations and decide where to take ships in distress."(OSIR 2009.)

Before the governments had absorbed new legislation containing Erika I and II packages, next great oil accident happened in Europe when the oil tanker Prestige sank off Northwestern Spain. That accident put pressure on EU states to pass legislation early and prompted the commission to toughen contents of the Erika I package. (Young 2003.)

6.3 The Prestige Accident

The single-hull oil tanker, Prestige, suffered a serious accident in the Northwest of Galicia in Spain on November 13, 2002 while carrying 77 000 tons of oil (Loureiro et al. 2006). The Prestige was sailing under the flag of Bahamas (Höfer 2003). Galicia has dangerous waters and at that time there was stormy weather. Galicia locates close to one the busiest shipping routes in the world and there is a refinery in one of Galicia's largest ports. In consequence of that five out of eleven major oil spills in Europe in the last three decades have happened in Galicia. (Loureiro et al. 2006.)

The Prestige was in danger of sinking because of a large crack in the starboard side of the hull and several thousand tons of heavy fuel oil was spilled into the sea. The Dutch salvage company took the control and the ship was towed to sea. After that the ship structure collapsed and the tanker broke into two. (EC 2002.) On November 19, the

Prestige sank 222 km away from the Cies Islands and polluted over 1 300 km of coastline in Spain, Portugal and France (Loureiro et al. 2006). Even 63 000 tons of oil was spilled (Huijer 2005).

Jus like the Erika, the Prestige was converted to segregated ballast but not coated (Devanney 2006).The Prestige oil spill was a serious environmental disaster and the most serious in Spanish water (Loureiro et al. 2006). Heavy crude oil, like carried in the tankers Erika and Prestige, is very persistent and hard to clean (EC 2002). During the period 2002−2004 short-term losses in economic sectors in Galicia, environmental losses, as well as cleaning and recovery costs, amount to € 566.97 million while excluding all other financial and future losses (Loureiro et al. 2006). The losses in the whole affected area were € 770.58 million during the same period (Loureiro et al. 2006) but it has been estimated that the total cost that has been spent after the Erika and the Prestige disasters are over 1 billion euros (EMSA 2009).

The Erika and the Prestige had passed many port state inspections before their structural failure. The Erika had undergone eight port state inspections but just superficial deficiencies were found. Because port state inspectors, like the Paris MoU inspectors, do not go in the tanks it was almost impossible to discover the bad condition of the Erika. (Devanney 2006.) If port state inspectors go in the tanks possible deficiencies could be discovered more certainly.

The Erika and the Prestige oil spills were caused by structural failures (Devanney 2006). According to Devanney (2006), if hull structural failures could be eliminated, even half of the volume spilled and tanker casualty deaths could be averted. The Prestige and the Erika were both flag of convenience ships (FOC). Flag of convenience ship is registered in other country than the country of ownership. Some countries offer for example cheap registration fees and therefore flag of convenience may be very attractive. Countries like this are for example Panama, Liberia and Bahamas. (Burgherr 2007.) Liberia receives just little coastal pollution and therefore it has not so big incentives to regulate the pollution. Many tanker owners have then taken advantage of that and 15 to 30 % of all tankers register in Liberia. (Young & Levy 1999.) The Torrey Canyon was one of them (Scanlon 2001). It is known that many flag of convenience ships are dangerous (WWF 2003). In the study made by Burgherr (2007) FOC countries had higher spill numbers and volumes than other country groups.

6.4 Accelerations in Erika Packages

The Prestige accident illustrated that there were not enough oil combatting ships in Europe. So EMSA set up a network of vessels and other resources to help Member States deal with pollution from ships. In 2009 there will be a comprehensive fleet of Standby Oil Spill Recovery Vessels (OSRV) available in all major European sea areas. (EMSA 2009.)

The Prestige disaster made the European Commission to accelerate:

"the phase-out of single-hull tankers serving in the oil trades of the Member States and to prohibiting the carriage of heavy grades of oil in single-hull tankers to or from ports in the EU Member States" (Urrutia 2006.)

"The publication of an indicative black-list of substandard ships that would have been denied access to EU ports under the new Port State Control Directive" (EC 2002).

"The establishment of the European Maritime Safety Agency. Despite the fact that the European Council was not able to agree upon the Agency's location, the Commission decided to set it up provisionally on its own premises in Brussels."(EC 2002.)

When EU accepted Erika I and Erika II packages to be part of its legislation it was the first time when EU implemented safety rules in the maritime sector that represented a deviation from the IMO rules (Urrutia 2006). The Commission also proposed to IMO (International Maritime Organization) additional safety measures for the transport of the "heavy fuel" oil (EC 2002).

6.5 Double-Hull

The aim of the double-hull regime is to reduce the probability of oil outflow (COPA 1998). The Committee on Oil Pollution Act of 1990 projected in 1998 that when all single-hull vessels are replaced by double-hulls "four out five oil spills attributable to collision and groundings would be eliminated and a two-thirds reduction would be realized in the total volume of oil spilled from collisions and groundings"(COPA 1998).

The segregated ballast volume is wrapped around the cargo tanks in a double-hull tanker. So the segregated ballast volume protects the cargo tank of breaking down. If grounding does not penetrate the ballast volume, the cargo tank does not break down and the spill will not occur. The double-hull is effective to prevent certain kind of small spills (See chapter 7). (Devanney 2006.) For example it has been studied that the probability of zero outflow in the occasion of collision or grounding is four to six times higher for double-hull tankers than for single-hull tankers (COPA 1998). Double sides are also effective oil containment devices when the damage is below the waterline. On the other hand the cargo tank leak will be into the ballast tanks where an explosive concentration of hydrocarbon vapor can build up and cause an explosion if the leak is not noticed. The other down side is that the coated area in segregated ballast tanks is eight times bigger than in a pre-Marpol tanker and in double-hulls ballast tank coated area is three times bigger than in Marpol single-hulls. (Devanney 2006.) According to Devanney (2006)" failure to maintain ballast tank steel has put far more oil on the water than any other cause".

It has been estimated that the capital cost of a double-hull tanker is 9 to 17 % higher than for single-hull tanker and operating and maintenance costs are 5 to 13 % higher. The total cost of the phase-out is estimated to be 30 million dollars worldwide. However, increased costs in transportation, by double-hull, comprise very small portion of the total cost of delivered oil. (COPA 1998.)

WWF (2009b) is afraid of the problems that may appear because of the phasing-out schedule. According to Höfer (2003) there is always a risk associated to phasing-out schedule. The reason for this is that within the last years of the ships, they are not managed by quality ship operators or good classification societies and ships may be registered under flags of conveniences (Höfer 2003). This can increase the number of accidents. In addition, there are only a limited number of places where double-hull tankers can be built and therefore there is a concern about building vessels too fast and compromising design standards (WWF 2009b). According to COPA (1998) the shipbuilding capacity will meet the demand of building new double-hull tankers although the construction prices will arise caused by bunching of orders and then the economic impact would be greater than estimated. The maintaining of double-hull tankers is also difficult and according to estimations of WWF massive oil spills from double-hull tankers will be seen in a few years (WWF 2009b). However, when double-hulls are well designed they will better prevent oil outflow after an accident than single-hulls. So the Committee on Oil Pollution Act of 1990 believes that after total conversion to double-hulls the protection of the marine environment will be much better. (COPA 1998.)

7. THE PROPONTIS ACCIDENT IN THE BALTIC SEA

Baltic Sea is a shallow brackish water area where natural cleaning processes are slow. One big oil accident could foul the whole coast of Gulf of Finland (Hietala & Lampela 2007) and would cause an ecological and economical disaster (Hänninen & Rytkönen 2004). Therefore the prevention of oil spills is very important in the Baltic Sea. There are groundings two times more in Finland than in other parts of Western Europe because of the narrow routes and shoaly coast (FMA 2008). The Baltic Sea and especially the Gulf of Finland has a high probability to oil spill risk because of the dense marine transportation, major oil tankers and difficult ice navigation conditions during the wintertime (Hänninen & Rytkönen 2004). (Figure 7.1). In 2007 one major oil accident was very close to happen and partially good luck saved the Gulf of Finland from oil spill accident.

Figure 7.1. The Gulf of Finland has difficult ice conditions. (Tapani Luoma 2008)

On February 2007 the Greek-registered crude oil tanker Propontis grounded in the Gulf of Finland west of Suursaari (HS 2007). The Propontis carried 100 000 tons of oil and it was on its way from Primorsk to England. The Propontis was built in 2006 and it is a double-hulled tanker. Divers found out that the grounding caused cracks in the bow and two 20−40 cm dents in the right side. (SYKE 2007.) There were ruptures in the ballast tanks but not in the cargo tanks (Neste Oil 2007) so the tanker did not spill oil into the sea (SYKE 2007). After the grounding tugboat convoyed the Propontis to two different anchorages near Porvoo before the berth in Kilpilahti oil harbor became free (SYKE 2007). There the Propontis was unloaded (FMA 2007). Neste, the Finnish oil company, bought the cargo (HS 2007).

According to Kujala (2007) the Propontis was sailing in the area where the deepness of the water is in nautical chart less than the deepness of the vessel. Therefore avoiding the grounding is impossible. Kujala (2007) thinks that the only reason why the grounding did not cause the oil spill was that the rock was not high enough to damage the upper part of the double-bottom. So in this case the double-bottom prevented the possible oil spill. There are also speculations that if the crew had had more experience of winter navigation the Propontis accident could have been avoided (Nikula & Tynkkynen 2007). WWF demands that the crew sailing in the Baltic Sea should have winter navigation skills like the Finnish Maritime Administration has proposed (WWF 2007).

According to WWF the deficiencies in the Mandatory Ship Reporting System in the Gulf of Finland (GOFREP) and Vessel Traffic Service (VTS) have to be found out and rectified together with Finland, Russia and Estonia. For example the Propontis sailed half of an hour off the route without Russian vessel traffic operators noticing it. WWF also demands that after every grounding or collision the authorities of Finland, Estonia and Russia have to analyze together why it happened, how the preventive inspecting and warning system functioned and how this can be avoided in the future. WWF demands that in the areas where navigation is difficult, like in eastern Gulf of Finland, it should be compulsory to use pilot. It also wants that tugboats will tug tankers to ports and wants that it will be determine if there is a need for own routes for major tankers. The major tanker transportation is increasing in the Gulf of Finland and the routes used in the Gulf of Finland are not proper for them in every way. (WWF 2007.)

Oil transportation has increased in the Baltic Sea (Asiantuntijaryhmän loppuraportti 2008) and the risk of major oil accident has increased at the same time. Especially Russian oil transportation has increased very fast. According to Kuronen et al. (2008) oil transportation will continue to increase during the next years. If the transportation growth is going to be the average there will be transported over 200 millions tons of oil in the Gulf of Finland in 2015 but if the growth is strong even more than 250 million tons will be transported (Kuronen et al. 2008).

The Gulf of Finland has not yet faced a major oil spill accident. Partly this is because of the good preventive systems like Vessel Traffic Service and international conventions but partly there has just been good luck. Good luck will not last forever and therefore it is very important to invest more money and time on oil spill prevention and response. (Luoma 2009.) Although Russia transports great quantities of oil it has not modern oil combatting vessels that could operate on the open sea and collect oil independently (Hietala & Lampela 2007). Finland's oil combatting capacity is one of the best in the Baltic Sea (Lampela 2008) but still the level of oil combatting is not as good as it is demanded in international conventions (Hietala & Lampela 2007). For example the oil combatting capacity of Finland is not sufficient if there happened an accident where 30 000 tons of oil was released in the Gulf of Finland (Hietala & Lampela 2007).

8. OIL SPILLS

8.1 Appearance

Every year, millions of tons of oil end up into the marine environment and even half of that are from marine transportation (Gottinger 2001). The oil spill may be caused by operational and accidental releases of shipping activities (Vanem et al. 2008). ITOPF has collected data of oil spills since 1974. Most oil spill incidents have been result of combination of different actions and circumstances. Most spills that are caused by tankers result from routine operations and majority of them are small. Operational causes are classified as loading/discharging, bunkering and other operations. Accidental causes give often rise to larger oil spills. Accidental causes are classified as collisions, groundings, hull failures and fire & explosions. (ITOPF 2007.) Only 25 % of the oil entering the sea through shipping is caused by accidental oil spills. The rest is caused by discharges made in the routine operations. (Gottinger 2001.) Tanker accidents cover then only 5−7 % of the total oil input into the marine environment. In this context, tanker accidents may not be seen to have so significant impact on the global environment. (Vanem et al. 2008.) But in reality one great oil accident may have a huge local impact on the marine environment and the consequence may be devastating especially in easily vulnerable areas like was seen after the Exxon Valdez accident. Therefore it is very important to prevent oil accidents before they happen.

If we look at the quantities of oil spilt in the world in one decade we see that just a few very large oil spills have caused a high percentage of the oil spilt. Therefore it is not that sensible to compare the quantity of oil spilt in different years because one major oil spill may have a great influence on the statistics. (ITOPF 2007.) Instead it is more sensible to compare the amount of oil spills because it shows how likely oil accidents occur.

Burgherr (2007) has studied accidental oil spills with at least 700 tons during the period 1970−2004. According to him numbers and volumes of large oil tanker spills have decreased significantly from 1970 to 2004, although, the seaborne oil transport by tankers has increased at the same time. This can be explained by the enactment of international laws and conventions, MARPOL 1978, OPA 90, International Management Code for the Safety of Ships and for Pollution Prevention (ISM Code), and SOLAS Chapter V (Safety of Navigation), in response to large tanker spills. The decreasing trend of large oil spills is shown in Figure 8.1. Between 1970−2004 spills over 100 000 tones occurred just with Pre-MARPOL single-hull tankers. Maximum spills for MARPOL single-hull was 74 700 tones whereas double-hull tankers caused only spills under 5000 tones. The dominant causes for the accidents that resulted in a spill of 700 tons or more were collision, explosion/fire and grounding. Together they accounted for more than 80 % of spills. (Burgherr 2007.) In recent years accidental oil spills have significantly decreased also in EU waters but still hundreds of different incidents happen every year. The majority of accidents are blamed on poor weather conditions and human factors. (EMSA 2009.)

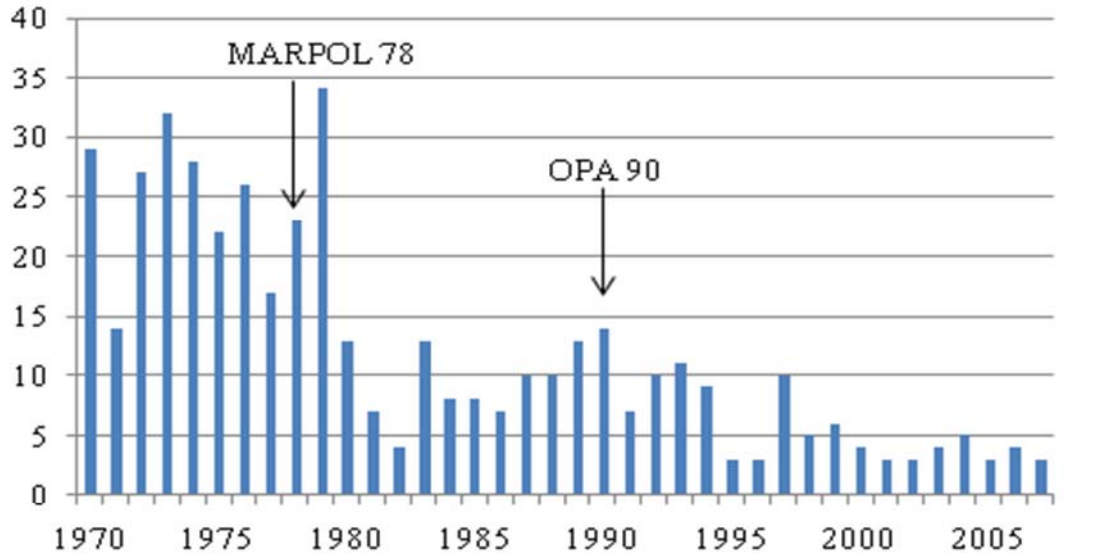

Figure 8.1. Number of oil spills over 700 tons in 1970−2005 (ITOPF 2007).

According to ITOPF (2008) hull failure was the most common cause of all accidental causes in the period 1974–2008 and gave rise to 709 oil spill incidents. However, most of the incidents caused spills less than seven tons. Groundings caused 583 incidents, collisions 577 and fire & explosions caused 134 incidents. (ITOPF 2008.) The phasing-out of single-hulls may have an impact on decreasing accidents that are caused by hull failures.

During the period 1995–2004 there occurred 232 tanker incidents that resulted spills of seven tons or more in over 60 countries. The USA had highest frequency (24 %) with 55 incidents. According to Huijer (2005) this can be explained by the fact that the United States of America are large oil importers and this causes heavy maritime traffic and great risk of accidental oil spill. The countries that experienced over 25 spills in the period 1975–2004 were USA, UK, Japan, Netherlands, Canada, South Korea, Sweden, Brazil, Singapore and Germany. In Europe most of spills had then experienced UK (79 spills), Netherlands (41 spills), Sweden (33 spills) and Germany (26 spills). The high number of oil spills in certain European countries is caused by the tanker routes. Great amount of oil is transported around the Atlantic Coasts to Northern Europe. Because oil transportation from Russia has increased, lots of oil is transported southward and westward along this route. Poor weather conditions, congestion and difficult navigation increase the risk of oil accidents in this area too. (Huijer 2005.)

8.2 Costs

Oil spills cause always direct and external costs. Direct costs include all direct loss of life, injuries, damage to environment, cargo and vessel. But external costs are more hidden are harder to quantify. External costs can include reduced worker productivity, economic loss claims, increased insurance costs, fines, lost opportunity etcetera. (Ornitz & Champ 2002.) It may be thought that big tankers cause biggest and most expensive spills but the truth is different. It is quite rare that the whole cargo is lost in an accident so big tankers do not necessary cause the most expensive oil spills. Actually quite small tankers have caused the most expensive oil spills (for example the Exxon Valdez). (Vanem et al. 2008).

There are many things that affect on the cleanup costs and therefore there are big differences in regional cleanup costs. The consequences of an oil spill will be dependent on where and when the release happens. Most important factors which influence on the per-unit costs associated with cleaning up are location, oil type and total spill amount. Other factors that may influence are for example weather, time of the year and management of the response operation. (Vanem et al. 2008.) On the other hand, according to Höfer (2003) there cannot be seen a very clear relationship between the spill volume and costs but the type of oil has important influence. Usually oil with a lower density evaporate faster and have then less severe impact (Eide et al. 2007). Heavy fuel oil, like in the Erika and the Prestige accidents, stays long in the environment and can drift far away (Höfer 2003).

Liability rules try to compensate injured parties for oil spill damages and therefore valuation of economic costs is important. It is also an important decision making tool when assessing the optimal level of protection that should be employed in marine safety in order to avoid oil spills. (Loureiro et al. 2006.) It is very important to prevent all large oil spills because prevention protects the environment but also reduces costs (COPE 1998).

8.3 Prevention

There can be found six different participants in the regulatory process in relation with oil spill prevention. They are classification societies, United Nations, flag states, coastal states, IMO and ILO. Classification Societies regulate the technical and operational standard of ships and class the vessels. After that the ship owner can get the insurance for his vessel. Classification society is the regulatory system of shipping industry and nowadays there are over 50 classification societies in the world. United Nations sets the framework of maritime law, IMO is the international maritime organization in response for safety and security and ILO is in response for regulations governing people on board, flag states govern the ships flying under their flags and the laws of the coastal states has impact on the ships sailing their waters. (Stopford 2008.)

Classification Society have to make sure that unsafe ships will not sail but on the other hand they have to keep the customer happy so that he does not take the ship to another

Classification Society (Devanney 2006). Devanney (2006) criticizes the Classification Society system and says that it must be dispensed with. The reason why he thinks the Classification system does not work is that the regulatee chooses and pays the regulator. This may lead to a situation where ship even in a bad condition is fully approved by Classification Society like happened with the Erika. Devanney (2006) thinks that Flag State control is ineffective because Flag States just strengthen the Classification system. Some Flags are competing for owners and offer therefore good deals for ship owners (like Flags of Convenience, see chapter 6.3) (Devanney 2006).

Human errors have caused many accidents and this has been shown also in this paper. For example the Torrey Canyon and the Exxon Valdez accidents were partly caused by human error. Rothblum et al. (2002) has studied human error and marine safety. According to them some form of human error has caused, at least partly, about 75–96 % of marine casualties and 84–88 % of tanker accidents. Therefore the maritime casualty rate has stayed high (Rothblum et al. 2002). The International Safety Management Code (ISM code) has been established to decrease the occurrence of human errors. (See e.g. Lappalainen 2008). Now when the ISM code has been mandatory over a decade the safety culture has emerged in the maritime industry. However behavior based on the old day's maritime culture is still found. (Lappalainen 2008.)

There are various things that motivate to avoid oil spills: economic, scientific/environmental, business, legal, and public opinion. All these motivators should be used to prevent oil spills. (Ornitz & Champ 2002.) However, the best way to protect the marine environment is to create a "safety culture". The adoption of the safety culture requires that the ship owners will adopt the International Safety Management Code (ISM Code), quality of management in all aspects of ship operation will be relied upon, money will be spent into maintenance, the ship systems will be upgraded, qualifies individuals will be trained and professionals will be employed. (Ornitz & Champ 2002.)

It is also important that ship owners will understand the long-term economic values of enforcing the safety culture. It is worth to invest in safety because money spent in front end saves lots of money spent later. In the safety culture the protection of the environment is seen as "good business". It is delightful that the commitment to safety is nowadays becoming more important for the ship owners and especially for the oil tanker owners. (Ornitz & Champ 2002.) For example industry performs own inspections, called vetting inspections, on tankers to eliminate substandard vessels and to ensure safety (Knapp & Franses 2007c). They are performed on behalf of cargo owners like oil majors but (Knapp & Franses 2007c) ship owners may also ask for the inspection to prove that the vessel has a required quality level (Knapp & Franses 2006). Ship owners have a strong commercial incentive to comply to the requirements of the vetting inspection because the outcome of inspection determines if the ship can get the cargo (Knapp & Franses 2007c). When ship owners invest in safety they will gain public trust and respect which has a positive impact on commercial benefits. (Ornitz & Champ 2002.)

It is expected that vessels with a good safety management have less serious casualties with less pollution (Knapp and Franses 2009). So if the attention is focused on substandard ships the environmental risk can be lowered (Eide et al. 2007). The study made by Knapp & Franses (2007b) based on 183 819 port state control inspections in 1999−2004 demonstrates that smaller vessels have higher risk for very serious casualties than bigger, detained vessels have high probability of casualty and age of the vessel is significant factor for very serious casualties. Over 20 years old ships have more accidents than younger vessels (Höfer 2003). When ships are 20 years or more the risk of sinking is multiplied by 25 (EEA 2003). Therefore it is important to ensure that especially older ships are well-maintained and regularly inspected. To improve the maritime safety it is also important to learn lessons from already happened oil accidents and try to avoid the same mistakes (EVOSTC 2009).

9. CONCLUSION

In the early days more attention was paid on preventing operational pollution than preventing pollution from tanker accidents. Later on, the importance of preventing accidental oil spills was understood and new conventions were adopted.

As we have seen in this paper there have been improvements that have increased the marine safety. For example vetting and port state controls have forced worst operators to get out of the business. All segregated ballast tanks of tankers are now coated and new technology has decreased collision and navigation errors. (Devanney 2006.) Also the phasing out of single-hull tankers has prevented especially small oil spills. So improvements have been done but even more is needed to decrease the probability of a major oil accident. According to WWF (2009a) oil spill response equipments should be tested more in extreme weather conditions like in the Arctic. In addition the Erika and the Prestige oil spills have proved that when inspectors do not go in the tanks they may not notice some serious deficiencies. Therefore port state controls inspectors need to start to go in the tanks.

The conventions studied in this paper focus more on ship structure and operations than human factor although human error seems to have very significant role in many tanker accidents. Therefore focusing on human factor seems to be very important when decreasing the marine casualties and tanker accidents.

As it has been shown many of the most important national and international conventions and amendments (like MARPOL measures) relating to maritime safety have been adopted after major oil accidents (IMO1998). The oil tanker accidents studied in this paper, the conventions related to them and the main content of the conventions is shown in the Table 9.1. These conventions have enhanced maritime safety and the number of oil spills has decreased while marine transport has increased. According to Huijer (2005) it is believed that especially MARPOL 73/78, OPA 90 and SOLAS 1974 (International Convention for the Safety of Life at Sea) has had a great impact on the decreasing trend.

It can be criticized that do we always need a major oil accident before new conventions can be adopted and is it really so hard to adopt preventing measures. However, according to IMO (1998) it is not necessarily a bad thing that new conventions have been made as in a response to major oil spills. The public outcry has ensured that oil majors want to invest in pollution prevention to save human life, money and to avoid bad publicity (IMO 1998).

Besides adopting new conventions it is important to amend them regularly and maintain them relevant (EVOSTC 2009). Although new conventions have improved maritime safety it seems that if we want to avoid oil tanker accidents in the future we need major changes in the safety culture. It is also important to remember that it is not free to prevent oil accidents. Preventive measures and increased compensation will lead to higher oil prices (Faure & Hui 2003). Faure and Hui (2003) say that public should be

ready to pay this price. Preventive costs are still cheaper than the costs after oil accidents.

It has been shown in this paper that the Baltic Sea is very vulnerable marine environment and therefore the oil combatting is very important in the Baltic Sea and especially in the Gulf of Finland. Winter conditions are also challenging in the Baltic Sea and to decrease the number of accidents in the winter time WWF wants that crew sailing in the Baltic Sea should have winter navigation skills. WWF also demands that tugboats should tug tankers to ports and in the areas where navigation is difficult it should be compulsory to use pilot. Also the deficiencies in GOFREP and VTS have to be rectified. (WWF 2007.) Finland should not be and it cannot be the only country to take response of the oil combatting in the Gulf of Finland. More international cooperation, especially with Russia, is needed to save the Baltic Sea and the Gulf of Finland from ecological disaster. (Luoma 2009.)

We should always remember that a new major oil accident can happen anytime and we have to do everything to avoid that. Although lots of improvements have been done there are still lots of improvements to make and we can never be too satisfied on the current situation. Despite all the great oil spills in the world, complacency is still one of the biggest threats to oil spill prevention (EVOSTC 2009).

Table 9.1. Oil tanker accidents and Conventions related to them

Accident	Torrey Canyon, 1967	Amoco Cadiz, 1978	Exxon Valdez, 1989	Erika, 1999 and Prestige, 2002	Propontis, 2007
Convention	MARPOL 73/78	Paris MoU	OPA 90	Erika I and II packages	-
Main Content of the Convention	monitoring of oily water discharges reception facility requirements segregated ballast tanks requirements defining special (vulnerable) areas requirements for oil carrying ships crude oil washing system in 1992 first schedule for phase-out of single-hulls	inspecting 25 % of the foreign ships creation of the inspection standards expanded inspections for high-risk ships establishing Black-Grey-White lists	phasing-out of single-hulls operational requirements for single-hull tankers ship owner or operator responsible for the cost of pollution incidents (clean-up and compensation) Foundation of Oil Spill Liability Trust Fund Oil spill response plan requirements	*Erika I* strengthened port state control in EU ports stricter monitoring of classification societies phase-out of single-hull oil tankers by 2010 *Erika II* establishment of EMSA new basis of a vessel traffic monitoring and information system the COPE fund *After Prestige accident:* setup of network of vessels acceleration of: phase-out of single hulls publications of black-list establishment of EMSA	-

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