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Application of Root Cause Analysis in Marine Accident Investigation:

Case Study

SMIT Transport & Heavy Lift Europe

by

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Abstract

The main objective of this thesis was to find the root causes of accidents that have resulted in damages. In order to find the root causes, the Root Cause Analysis methodology was applied on the information supplied by the business unit of SMIT Transport & Heavy Lift Europe.

When applying the RCA, it was realized that the quality of the data available did not permit the full application of the RCA, since the result was either a repetition of several types of generic causes or a wide variety of types of causes, making the correlation of causes to the incidents a difficult challenge.

As such it was decided by mutual consent with SMIT to search for the direct cause and to apply a more practical classification in the form of operation, administrative, technical, external or environmental factor. As a result it was brought to the attention that roughly fifty percent of the events are directly caused by operational factor.

Apart from finding the direct causes, this thesis researched the monetary effects that the damages had on the business unit under investigation. This effect was measured by using the available Hull & Machinery insurance information and analyzing the proportion of damages that could be legally claimable and the quantity of events that were actually claimed. The result is that during the period of time been analyzed, only 3% of all the damages were claimed from the insurance company, and the remaining 97% of the damages had a value lower than the standard premium.

Finally by using the rest of the information available, it was possible to confirm that damages are not influenced by only one variable, but instead, they are triggered by many external and internal variables making it an unexpected event. Also in this particular case, the market of the business unit studied is driven by many other markets like dredging, wind energy technology and infrastructure, all of which can rely either on government funding or on private investment, making it difficult to correlate the amount of damages suffered with the business cycle. Thus, the occupancy rate of the vessels, defined by SMIT as the amount of days per period of time that the vessel is productive, could give more insight on whether the amount of damages are related to the business cycle.

Besides the above, some assumptions could be made by analyzing the database. Between others, it was noted that the amount of damages reported can be influenced by the following variables: i) seasons, ii) dry-dock period that allow to discover damages and thus large numbers of events are reported in a short period of time, and iii) that the crew mentality plays an important role on the number of incidents that are actually reported.

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List of Abbreviations

AHTS	: Anchor Handling Towing Supply Vessel
ATL	: Actual Total Loss
CEO	: Chief Executive Officer
CTL	: Constructive Total Loss
DNV	: Det Norske Veritas
DSV	: Diving Support Vessel
EMCIP	: European Marine Casualty Information Platform
EMSA	: European Maritime Safety Agency
GRT	: Gross Register Tonnage
H&M	: Hull and Machinery Insurance
hp	: Horse Power
ILO	: International Labour Organization
IMO	: International Maritime Organization
ISM	: International Safety Management Code
JHC	: Joint Hull Committee
MAIB	: Marine Accident Investigation Branch
MARS	: Management of Accidents & Registration System
OHSAS	: Occupational Health and Safety Management Systems
P&I	: Protection and Indemnity Insurance
RCA	: Root Cause Analysis
SHE-Q	: Safety, Health, Environment and Quality
SMIT	: Smit Internationale N.V. (parent company)
SOLAS	: Safety of Life at Sea
THLE	: SMIT Transport & Heavy Lift Europe
WHO	: World Health Organization

Chapter 1 Introduction

1.1 Introduction

Maritime Accidents take place every day all over the world, and they often make the first page news when lives have been lost or environmental catastrophes are a result of the accident. Two clear examples of this have been the Titanic and the Exxon Valdez, and more recently the oil spill in the Gulf of Mexico due to the explosion of a drilling rig.

It is known that once such a regrettable event happens, many institutions are involved in the investigations. These investigations may start close to home, been carried out by the branch of a company or the company itself, or international institutions like the Marine Accident Investigation Branch - MAIB.

The main objective of investigating an accident is to determine its circumstances and the causes. This is done in order to improve the safety of life at sea and to avoid accidents to happen in the future.

In general, investigations are not very welcome, since people often believe that the whole reason of the investigation is to find someone to blame. This is the reason why the first step the investigator needs to take is to assure all the people involved that the objective of undergoing investigations is to prevent accidents by learning from past mistakes.

Maritime Accidents may have other consequences besides the two previously mentioned. They can also result in injuries, asset damages, and if lucky, in near misses.

Although all of them are important, this thesis will focus on the accidents that resulted in damages of assets, using the information available at a business unit of SMIT International.

The objective of analyzing such information is to find out the root cause of the accidents that resulted in damages. But, when applying the RCA, it was realized that the quality of the data available did not permit the full application of the RCA, since the result was either a repetition of several types of generic causes or a wide variety of types of causes, making the correlation of causes to the incidents a difficult challenge.

As such it was decided by mutual consent with SMIT to search for the direct cause and to apply a more practical classification in the form of operation, administrative, technical, external or environmental factor. As a result it was brought to the attention that roughly fifty percent of the events are directly caused by operational factor.

Thus the following research questions were formulated.

1.2 Research Questions

The main research question of this thesis could be phrased as:

1. What are the causes of marine accidents, which have resulted in damages, suffered by assets (vessels), belonging to SMIT Transport & Heavy Lift Europe?

In order to attain a significant and reliable answer, this thesis is supported by a database containing all reported incidents that have taken place during the last 5 years (01.01.2005 - 30.06.2010), and that have resulted in damages. The information is drawn out of the MARS system, which is used by SMIT to register all the incidents taking place in all its business units.

Once the information has been filtered to match the thesis requirements, it can be use to answer the secondary research questions, which are the following:

2. To what proportion are damages claimed to the insurance company?

3. What is the financial impact of the claims for the SMIT Transport & Heavy Lift business unit?

4. Are there any factors that this business unit should take into account in order to improve its performance in reducing the amount of damages?

As mentioned before, these research questions will be investigated by analyzing the existing database and the claims submitted to the underwriters. The fourth question will be answered by drawing conclusions from the available data and giving an informed advice to the business unit under investigation.

1.3 Thesis Structure

This thesis consists of seven chapters. In the introductory chapter, the objective of the research and the corresponding research questions are elaborated as well as the origin of the information.

Following the introduction, Chapter 2 gives a general description of SMIT Internationale N.V., given that this thesis is based on the particular situation and information provided by a business unit of this company. In this chapter the reader will learn about the company history, core activities and organizational structure. It will also describe the services offered by the Transport & Heavy Lift division and will follow by focusing on the business unit subject of this study, Transport & Heavy Lift Europe. The chapter will end with the role that the department of Safety, Health, Environment & Quality (SHE-Q) plays in the organization and its involvement with this thesis.

Chapter 3 presents the reader with basic information and definitions that will enable him to understand the concepts of accidents and damages. The chapter will define the word ´hazard´ and break it down into its different outcomes until reaching the term, ´damages´. It continues by mentioning different sources that have researched the main causes of maritime accidents. Finally, an overview of the amount of vessels involved in accidents in European waters, and some numbers on Total and Serious Losses gives an impression of what is the situation in the market.

The thesis continues with chapter 4, which provides the reader with knowledge regarding Marine Accident Investigation. It explains what marine accident investigation is and who is responsible for conducting such investigations. It then continues explaining how to undergo such an investigation by making use of the Root Cause Analysis and how this type of analysis is helpful for the investigation. It finalizes by describing the process and the different methods of root cause analysis.

Chapter 5 gives an overview of the standard cost structure that a shipping company might use, giving special attention to the types of operational costs. From operational cost perspective, the chapter emphasizes on the insurance and the repair and maintenance costs, both of them closely related to the subject studied.

This thesis continues to its core, chapter 6, where it has been described how the two sources of information or databases have been procured and the steps taken to filter the information until obtaining the final set of information subject to this investigation. The chapter continues with the analysis of the data in order to give answers to the research questions posed in the first chapter. It takes three approaches, the first one from the database of damages attempts to find the direct cause of the accidents as well as trends on the information available; the second approach used the database of the claims in order to find the financial implications the H&M claimed damages have on the business unit.

Finally the thesis closes with chapter 7 which is divided into two parts. The first section contains the conclusions that give answers to the four research questions posed at the beginning of this investigation. It also approaches other different data in order to find trends or factors within the information of the accidents that resulted in damages. The second part of the chapter is the recommendation based on observations made during the complete process of writing this thesis. These recommendations are mainly focused on the reporting process of the events and the means it is been done.

Chapter 2 Company Outline

2.1 Introduction

This thesis is based on the particular situation and information provided by the company Smit Internationale N.V.

In order to understand the circumstance and the source and type of information, this chapter gives a general description of the company in question.

The chapter begins with an overview of the company history, core activities and organizational structure. It continues by briefly describing the services offered by the Transport & Heavy Lift division and is followed by focusing on the business unit Transport & Heavy Lift Europe.

Given the nature of the study, i.e. damages on corporate assets (ships), the chapter winds up with the role that the department of Safety, Health, Environment & Quality (SHE-Q) plays in the organization and its involvement with the study in question.

2.2 SMIT'S Company Profile

Smit Internationale N.V. was created in 1842 by Mr. Fop SMIT with the purpose of providing vessels a safe passage into the port of Rotterdam, at that time, by means of a fleet of six tug boats (SMIT 2010a).

His legacy continued to be expanded, and once the experience was acquired in the towage business, the company's maritime knowledge allowed it to engage activities in the salvage market.

After nearly 170 years, SMIT has became an international company with operations in 50 locations around the world that offers a wide range of customer focused maritime services, mainly to shipping companies, oil and LNG industries, (offshore) construction companies, insurers, governments and shipyards (SMIT 2009a) .

SMIT's services are well known by their combination of expertise, experience, employment of high-class materials and equipment, and its high standards concerning safety, health, environment protection and quality (SMIT 2010a).

SMIT's services are divided into four core divisions:

Harbor Towage	:	berthing and unberthing of seagoing vessels, standby and port services.
Terminals	:	assistance (towage) to incoming and outgoing vessels; establish, commissioning and managing offshore and onshore terminals and render related maritime services.
Salvage	:	emergency response (salvage), wreck removal and environmental protection.
Transport & Heavy Lift	:	towage of floating objects, chartering, heavy lifting and marine support services (SMIT 2009a).

Nowadays, SMIT counts a fleet of 424 units (SMIT 2010a) under the administration of the above mentioned divisions and a workforce of 4.184 employees (Feenstra 2010).

Figure 1 shows the organizational structure of SMIT, characterized by the location within the company of the four core divisions and how they are supported by the remaining departments.

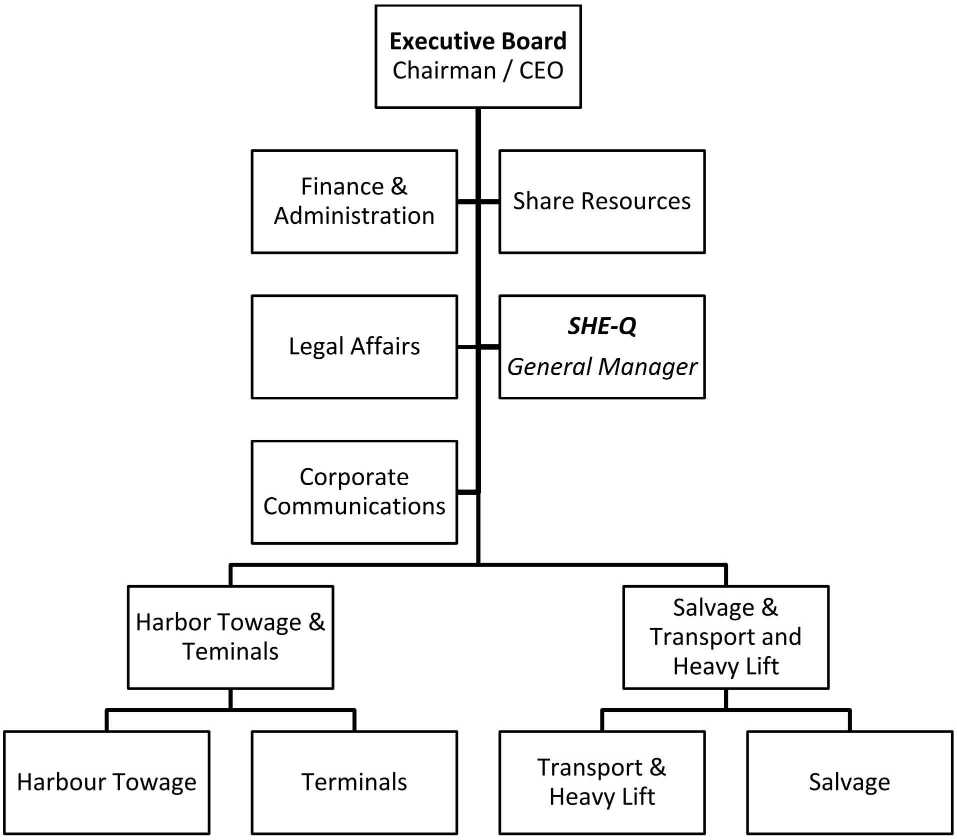

Figure 1: Smit International Corporate Organization
Source: SMIT (2010b)

2.3 SMIT Transport & Heavy Lift Division

As mentioned in the previous section, one of the core divisions of SMIT is Transport and Heavy Lift. This division provides potential customers with transport barges, self-propelled floating sheerlegs and different types of tugs and support crafts, among others.

The Transport & Heavy Lift Division catalogs almost all of the services it renders into two categories: horizontal and vertical.

Horizontal services refer mainly to marine transportation. These can be performed by (SMIT 2009b):

- Semi-submersible and flat top barges transporting project cargo of up to 24000 tons. Among others, such cargoes comprise dredgers, cranes and prefabricated structures.

- Work vessels, like AHTS, which can be chartered to serve operators in the oil and gas industry.
- Seagoing, river and estuary barge transport.
- Loadout and ocean transportation of civil structures.
- Loadout, ocean transportation and mating of offshore structures.
- Coastal and river towage.
- Ship management for third parties.

Vertical services are those involving heavy lift operations performed by means of the fleet of floating sheerlegs (ie. crane barges). These can be seen working at ports, shipyards, offshore construction facilities and major civil projects with a marine content. Heavy lift operations are regarded as the hoisting and positioning of heavy objects like columns, decks, flare, drilling towers, and components of bridges, tunnels and jetties.

Services that are not included in these two categories are marine and subsea projects. These services enable the management to undertake marine installation projects by means of combining resources and competencies available within the SMIT company and external resources offered through cooperation and partnerships with third parties (SMIT 2009b).

The Division of Transport & Heavy Lift has under its management a fleet of 129 vessels mainly comprising, as previously mentioned, AHTS, barges, tugs, DSV and sheerlegs (Claims Division 2009).

Based on the type of services and the desire to be able to offer them around the world, the Transport & Heavy Lift Division is sub-divided into business units. These units are illustrated in figure 2.

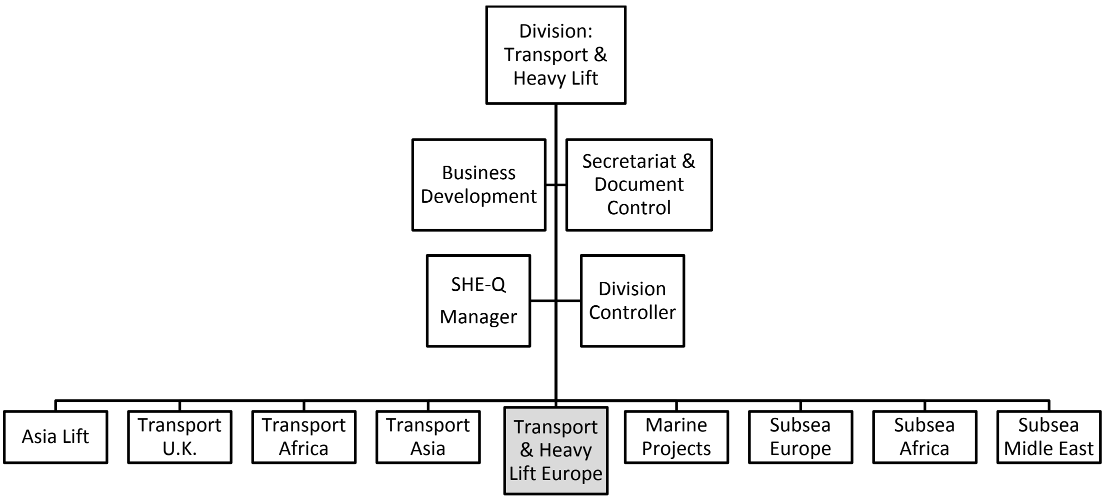

Figure 2: Transport & Heavy Lift Division Organization
Source: SMIT (2010b)

2.4 SMIT Transport & Heavy Lift Europe (Business Unit)

This business unit focuses its activities and resources on a specific group of customers in need of transportation and marine support services.

Figure 3 gives a clear view of the composition of the business unit of Transport & Heavy Lift Europe.

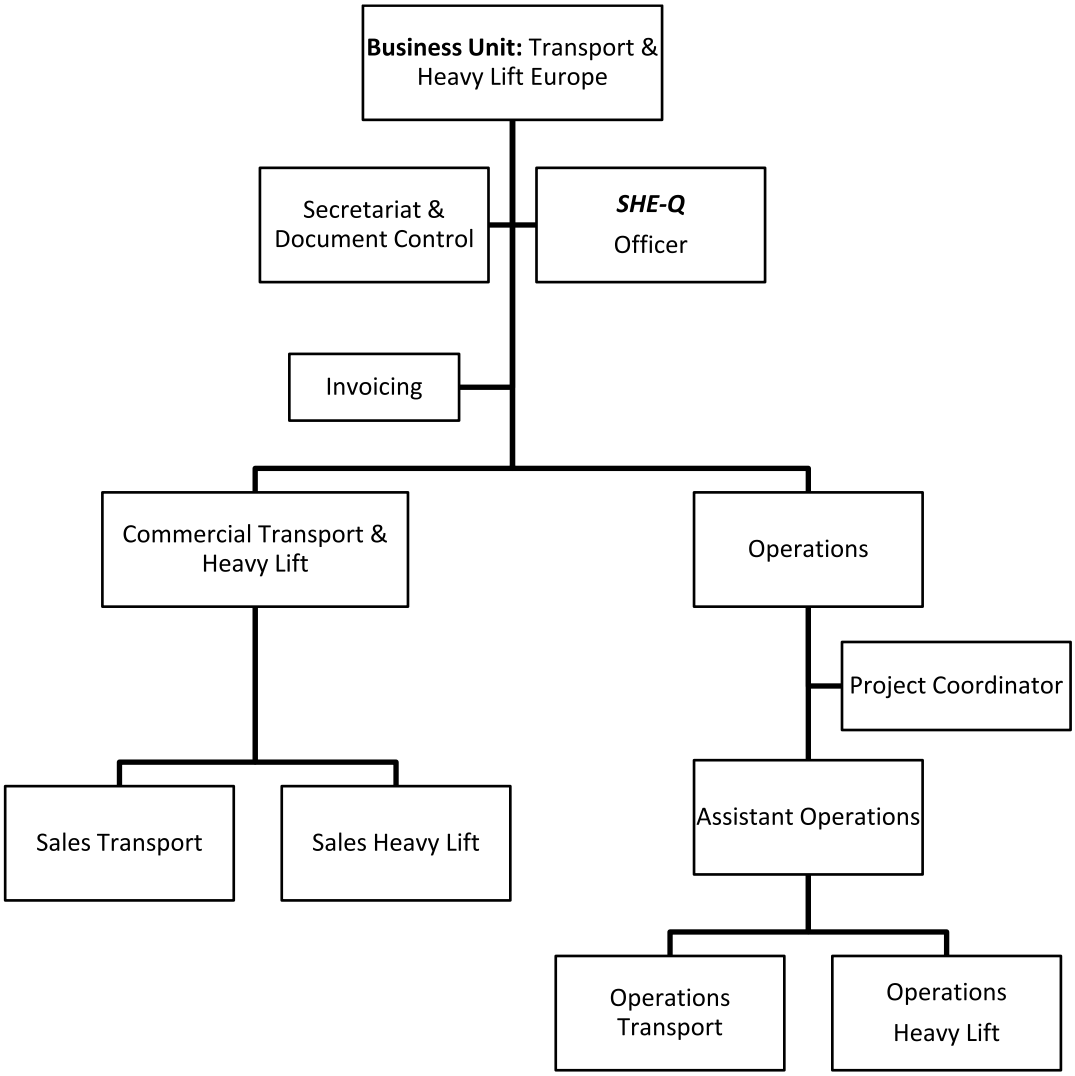

Figure 3: Transport & Heavy Lift Europe Organization
Source: SMIT (2010b)

This business unit, as its names suggests, markets its services in the Europe region. Nevertheless, it can occur that its fleet is deployed in other areas of the world either due to a service contract or because vessels have been chartered to a client or other business unit.

Out of the total fleet managed by the Division, the business unit owns 76 of these vessels. The fleet is composed by:

Table 1: Fleet composition for SMIT Transport & Heavy Lift Europe

Type of Vessel	Capacity	Amount
Inland barge	2000 tons	30
Seagoing floating sheerleg	3000 tons	4
Seagoing barge	8000 tons	20
Seagoing barge	14000 tons	1
Seagoing barge	24000 tons	3
Harbor / river tug	1000 hp	1
Harbor / river pusher tug	2800 hp	5
Costal / harbor tug	3000 hp	1
Utility vessel		7
Various vessels		4

Source: Goudriaan 2010

2.5 Corporate SHE-Q Department

Safety, health, environment and quality are concepts that everyone in the organization endorses and must keep in mind in order to achieve the highest level in each of these aspects in everyday work activity.

Taking this into account, an organized chain of communication and division of tasks and responsibilities are necessary, in order to achieve SMIT’s goal of ´no accidents, no harm to people and no damage to assets and environment´ (SMIT 2003, p. 4). This explains the existence of the Corporate SHE-Q department.

As it can be appreciated from figures 1, 2 and 3, the concern for safety, health, environment and quality (SHE-Q) is present in all the layers of the organization in order to reach SMIT´s goals.

Figure 4 contributes with a better understanding of the role SHE-Q plays in the company.

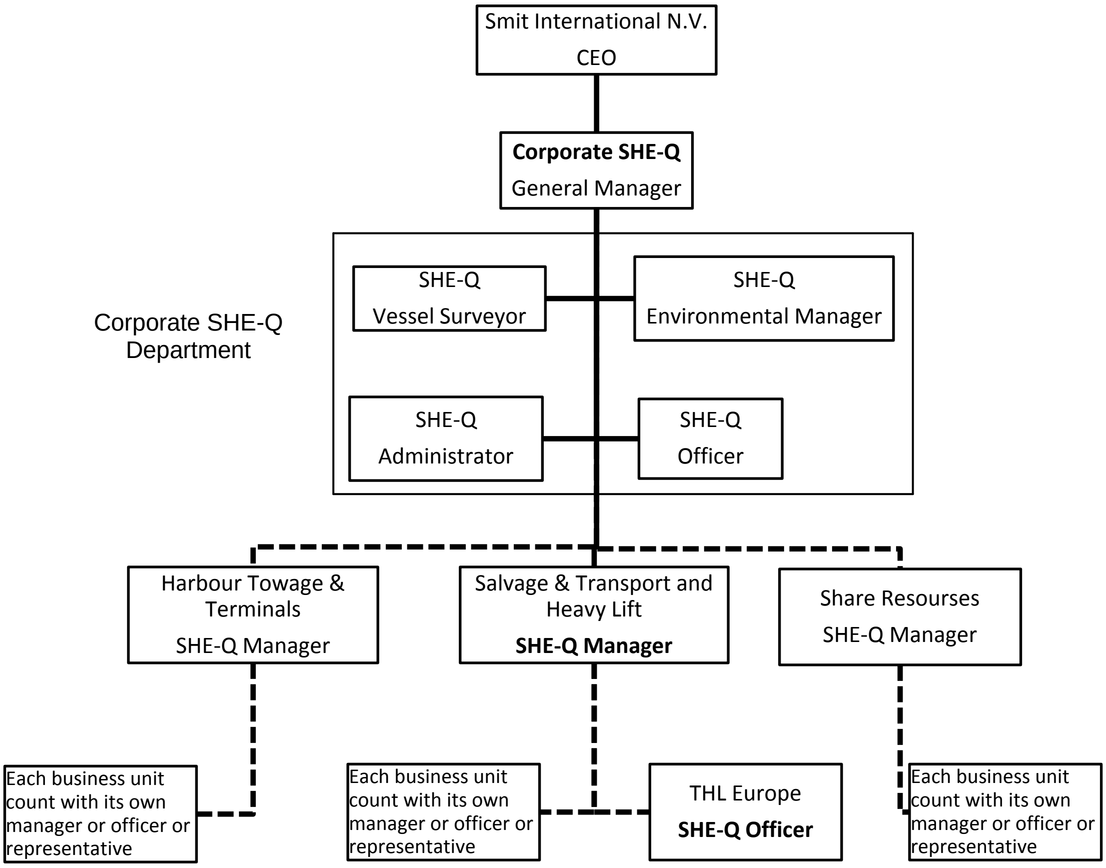

Figure 4: Corporate SHE-Q Organization
Source: SMIT (2010b)

Each SHE-Q manager or officer acts as a direct communication link between the top management and the workforce under his unit or division. It is also part of his activities to advise and provide support at all levels on SHE-Q matters and ensure that the division and/or business unit management system is properly established, implemented and maintained. Periodical reports of SHE-Q performance to the management and the planning and arrangement of audits, inspections and training lay under the scope of activities of these SHE-Q managers and officers.

As a result of the previously mentioned activities, the verification of effectiveness of remedial actions is the end result of their efforts. Last but not least, the members of the SHE-Q departments are in charge of providing awareness of internal and external customer requirements and promote the SHE-Q culture within their divisions and units.

The incident registration database under the responsibility of the SHE-Q department is called Management of Accidents & Registration System (MARS). This is a database that holds the registration and categorization of non conformities, incidents, claims and follow up actions of the entire SMIT organization. The main objective of this management system is to aid safety management via on time communications, analysis, distribution and learning from the experience of the incidents that have occurred in the past.

The Transport & Heavy Lift Europe business unit has created a flow chart indicating the standard method for reporting and registration of occurrences which have taken place at work or wile in service, within the premises, which ends as an entry in the management system MARS.

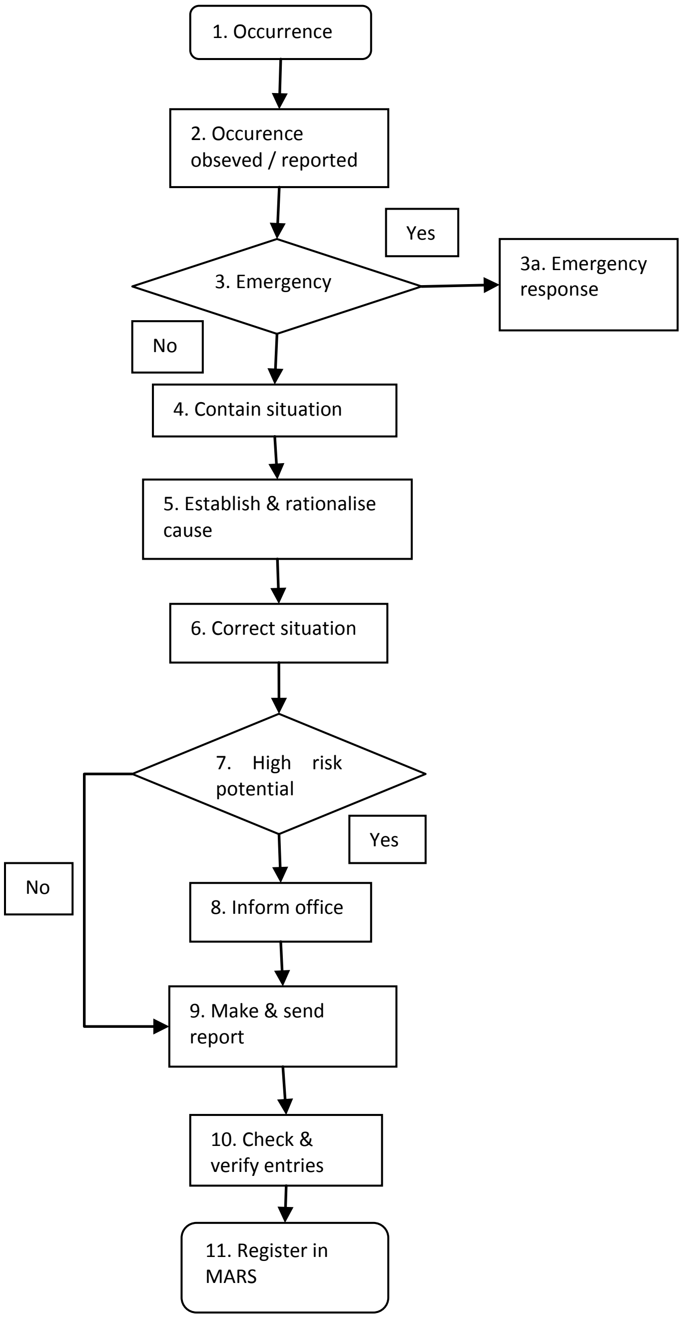

Figure 5: Reporting & Registering of Occurrences Flow Chart
Source: Kesser (2006)

Here below a brief description of the steps included in the Reporting & Registering of Occurrences Flow Chart.

1. The flow begins once an occurrence takes place.

There are many types of occurrences, better known as incidents, which can take place on a daily basis, but to be precise, the ones that are registered in the managing system MARS are of the following types:

- Personnel injuries
- Property damages
- Near misses
- Environmental pollution

2. The witness observes the event and proceeds to report it to the person in charge.

3. The person in charge has the task to decide if the occurrence is an emergency or not, and will proceed to activate the emergency response action if required.

   An emergency will be the situation that seriously threatens the safety of personnel, vessel and/or environment and requires immediate action.

4. The person in charge takes the necessary actions to contain the situation.

5. He then proceeds to establish the sequences of events and causes, and rationalizes what has happened.

6. Then the necessary steps are taken to start correcting the situation.

7. The person in charge decides the potential risks of the occurrence.

8. He then proceeds to inform the office/operations manager. In case of high risks, he will inform immediately, if no, he will do it as soon as practicable.

   In this step, the operations manager will continue to inform the higher management and staff functions accordingly, i.e. SHE-Q, Claims, Legal, PR, HR.

9. The person in charge documents the report as soon as practicable and sends it with the relevant supporting documents to the office/operations manager.

10. The operations manager or event registrar will proceed to check and verify the information in the documented report, he may ask for extra details from the person in charge.

11. And finally the operations manager will enter the data into the MARS system.

As mentioned in the introduction, this thesis focuses on the property damages, suffered by the business unit of Transport & Heavy Lift Europe, registered in MARS.

The following chapter gives the framework for understanding the concept of incidents and how damages derive from them. Moreover, the background theory of the causes of incidents or accidents will be discussed in order to finish the outline of this thesis.

Chapter 3 Literature Review of Maritime Accidents

3.1 Introduction

This chapter presents the foundation and definitions to understand the concepts of accidents and damages, which is the subject of this thesis.

The chapter opens with a set of definitions, outlining the chain of possible results from a ‘hazard’, all the way to the term of interest, ´damages´.

It continues by quoting different sources that, thanks to database sources and extensive research, have identified the main causes of maritime accidents.

Finally, a view of the last three years of the number of vessels involved in accidents, while in European waters, gives an impression of what can be expected from a business unit like THLE, the same as the statistics on Total and Serious Losses.

3.2 Definition of Hazard and its Ramifications

Before been able to take measures that will improve the safety conditions of a job and/or to minimize the amount of property damages suffered by a company, one should fully understand the nature of hazards.

Throughout the literature there are many definitions for the word hazard, but for the purpose of this study a hazard will be any situation that could cause harm in terms of injury, damage to property, harm to the environment, or a combination of these (NOVO 2000).

A hazard can be divided in three states (MacCollum 2006):

- Dormant : incapable to cause any harm.
- Armed : capable of causing harm.
- Active : causing injury, death, and/ or damages

For further explanation of the three states of a hazard, the following analogy can be used. The existence of Icebergs in the North Atlantic is regarded as a dormant hazard. Once a vessel is navigating at full speed, during the night, in the area where icebergs collect, the hazard becomes armed. The moment the vessel strikes an iceberg the hazard is active.

A hazard may result in an incident, which according to SMIT (2003) is an unexpected event, which caused or could have caused injury or illness, damage to assets or pollution of the environment.

Given the previous mentioned outcomes, an incident can evolve into the following two:

Near miss: if the incident did not cause any injury, illness, damage nor pollution.

Accident: if the incident resulted in actual injury, illness, damage or pollution.

In order to have a clear picture of what each one of the possible results entails, brief definitions are presented below.

Injury: harm suffered by the structure or function of the body caused by an external agent or force, which can be physical or chemical. People that suffer and injury may incur temporary or permanent disabilities The most common types of injuries are bruises, wounds, burns and fractures (WHO 2010).

Illness: a disease or period of sickness affecting the body or mind (Oxford 2010).

Damage: physical harm that impairs the value, usefulness, or normal function of public or private assets (Oxford 2010).

Pollution: introduction of contaminates into the environment that causes instability, disorder, harm or discomfort to the environment (Oxford 2010).

According to EMSA (2009), accidents can be divided into five types: sinkings, collisions / contacts, groundings, fires / explosions and others.

Having broken down the term hazard into its possible outcomes, and clearly defining the terms, the thesis continues with a focus on accidents that result in property damages.

3.3 Main Causes of Maritime Accidents

As mentioned before, and in this particular case, maritime accidents may lead to injuries, property damages and, in the worst case, death. Throughout the years studies and statistics derived from reporting systems have identified the many factors that can cause accidents.

Mankabady (1987), in his time, classified the possible causes into seven categories:

- Defects in the design, structure of the ship or failure of the machinery
- Nature of the cargo, fires, explosion and/or method of stowage
- Perils of the sea
- Sub-standard ships
- Working methods
- Human error
- War, sabotage and maritime fraud

The classification society Det Norske Verita´s (DNV), opted for codifying the causes into more detailed ones, where each division could be sub-divided into 10 or more causes.

The main divisions are:

- Circumstances not related to the ship (11 sub-causes)
- Construction of the ship and location of equipment on board (9 sub-causes)
- Technical conditions concerning equipment on board (10 sub-causes)
- Conditions concerning use and design of equipment (5 sub-causes)
- Cargo, safeguarding and treatment of cargo and bunkers (7 sub-causes)
- Communication, organization, procedures and routines (19 sub-causes)
- Individual on board, situation judgment, reactions (16 sub-causes)

Psaraftis et al. (no date), concludes in its paper, that a broad sub-division like the one offered by the code list of DNV, does not guarantee an easy identification of the cause of the accident. Going into too much detailed resulted in having different codes describing the same accident and/or that it was needed more than one of the codes to properly describe the cause of the accident.

More recently and based on a legal background, The Online Lawyer Source (2010) stated that the causes of maritime accidents could be categorized mainly as:

- Equipment malfunctions
- Extreme weather conditions
- Human error (negligence, recklessness, inexperience of crew or passengers)
- Intoxication of a vessels operator

At SMIT, eight years ago, and after an exhaustive study, the Marinco Survey (2002) identified the following as the main causes for which to issue a marine claim:

- Human failure (lack of training, operational error, negligence)
- Mechanical failure
- Equipment failure
- Fault of design
- Lack of maintenance
- Unfavorable and external cause
- Lack of procedures or incomplete procedure implementation
- Operation in hostile waters
- Management failure

3.4 Statistics on Maritime Accidents

To have an idea of the number of accidents that take place around the world, one could mention that in 2008, the U.S. Coast Guard responded to more than 27.000 incidents that resulted in 800 deaths and over $ 121 million in property damage (Online Lawyer Source 2010).

The European Maritime Safety Agency (EMSA) has been gathering, since 2007, selective and aggregated information on EU maritime accidents.

According to EMSA (2009), the amount of vessels involved in accidents during 2009 was lower compared to those of 2007 and 2008, but still higher than in 2006.

For illustration purposes, figure 6 gives a comparison of the number of vessels involved in accidents and the amount of accidents in the time period between 2006 and 2009. The slight difference between the two variables shows that in a small percentage of the accidents more than one vessel is involved.

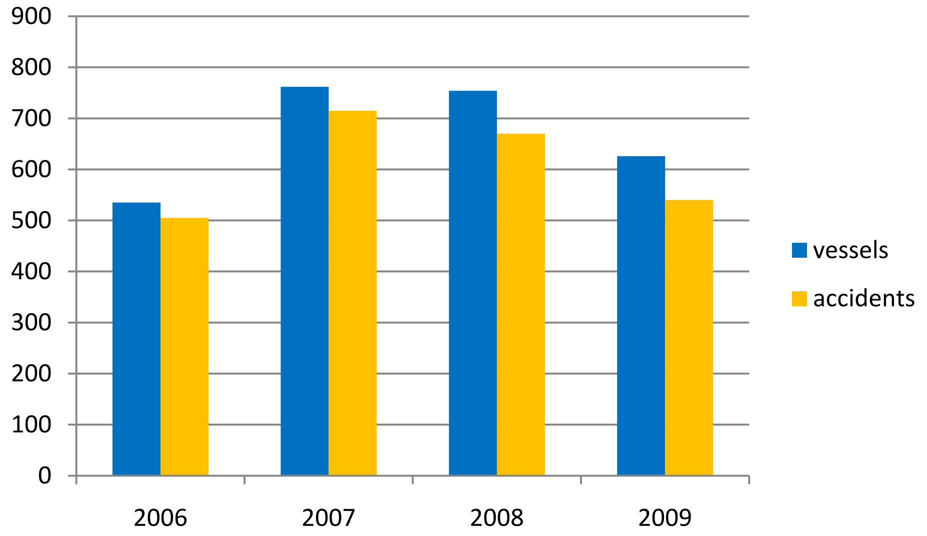

Figure 6: Number of vessels involved in accidents between 2006-2009
Source: EMSA (2009)

EMSA (2009) explains the decrease in number of accidents by stating that there is a correlation between the number of accidents and the financial circumstances of the shipping market. In order to confirm such correlation they will have to wait until 2012 to see the development in accident figures after the 2008-09 financial crisis and the subsequent improvement of the market.

If we try to determine the moment when most accidents take place, one could say that it is when ships and seafarers are worked harder, like it happened during 2007 and 2008 during the market boom.

In the case of 2009, the tonnage overcapacity, the increasing amount of vessels been scraped and slow steaming have been the main reasons for the reduction in accidents around the world. But not all of them really contribute to the decrease in accident numbers. Slow steaming may result in increasing numbers of engine failures and the decrease in income of ship owners and operators can lead to delay maintenance works and repairs, which in turn could lead to future causes of accidents.

EMSA (2009) reported that in 2009 in EU waters alone, 626 vessels were involved in 540 accidents consisting of sinkings, collisions, groundings, fires/explosions and other significant accidents. In that same year, 52 lives were lost.

Figure 7 gives an overview of the 626 vessels involved in an accident in 2009, categorized by tonnage.

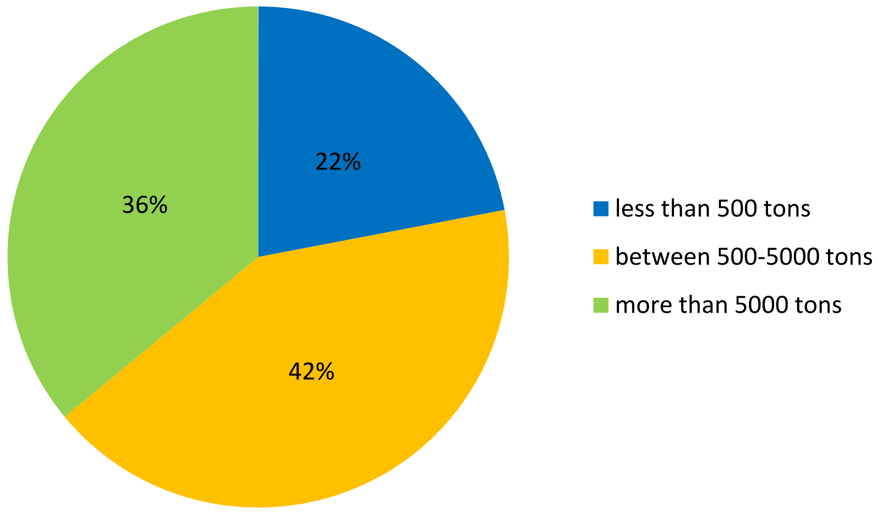

Figure 7: Vessels, by tonnage, involved in accidents in 2009
Source: EMSA (2009)

In the specific case of Smit Transport & Heavy Lift Europe, and looking back to table 1, it can be appreciated that the vessels, which form part of the assets of this particular business unit, would fall under the two largest categories of vessels involved in accidents in European waters.

Also the total amount of vessels involved in accidents has been subdivided, by EMSA, into ship types. In this case the category of Other Vessel Types would apply for the type of vessels that SMIT Transport & Heavy Lift Europe operates. Figure 8 provides this overview.

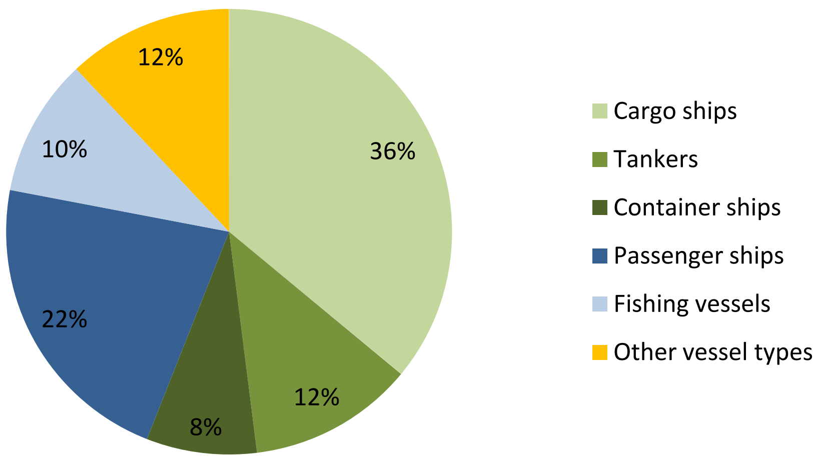

Figure 8: Accidents by Ship Type in 2009
Source: EMSA (2009)

3.5 *Statistics on Maritime Losses*

As mentioned in the first part of this chapter, accidents may have different results. One of the possible outcomes can be damages, which can also be categorized according to their severity.

A common damage, as previously defined, is the physical harm that diminishes the value and performance of the asset (Oxford 2010).

As the severity of the damage increases, it can be cataloged as:

- Constructive Total Loss (CTL), known as the damage to the property in such an extent that the property is beyond economical repair, in other words, the cost of repair exceeds the value it was insured for (Business Dictionary 2010).

- Total Loss or Actual Total Loss (ATL): is the a) damage to the property to the extent that nothing of value is left, and the object cannot be repaired or rebuilt to the pre-damage state. It can also take place when b) the property is completely destroyed, or c) the damage is such that is no longer the object that was insured, or d) can no longer be used for the purpose it was acquired for, or e) it disappears (Business Dictionary 2010).

The IUMI (2010) reported that for the year 2009 there were 67 total losses, a number that has been decreasing in the last couple of years as it can be seen in figure 9.

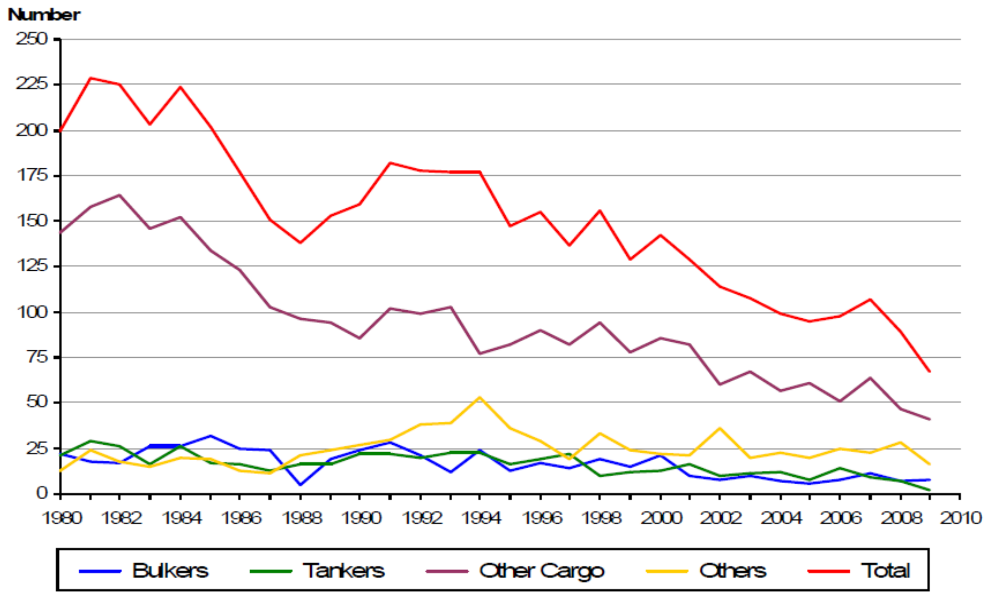

Figure 9: Total Losses 1980-2009, by number and for vessel > 500 GT. Source: Graham (2009)

For the particular case of this thesis, the category "Others" for type of vessel, is the parameter to focus the attention in this and the following figures.

Even though the number of vessels is decreasing, if the statistics are looked from the tonnage perspective, the picture is different. In 2009 the total tonnage lost was 463.000 GRT, compared to the 417.000 GRT lost in 2008. Figure 10 gives an overview of this trend.

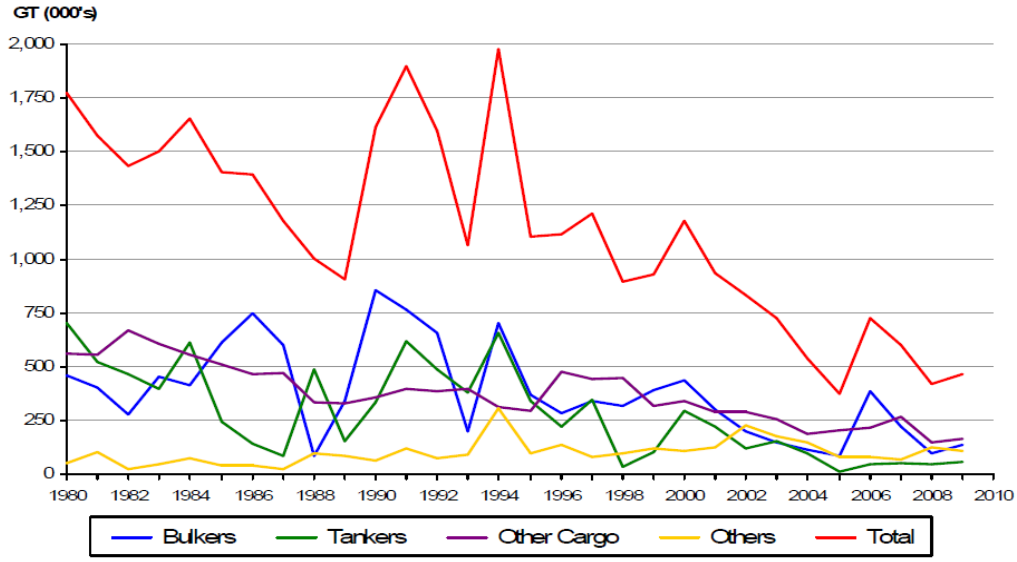

Figure 10: Total Losses 1980-2009, by tonnage and for vessel > 500 GT.
Source: Graham (2009)

The total losses have also been analyzed from the *cause* perspective. In this case the weather plays a big role by being the main cause of total losses, representing 43.2% between the years 2005 and 2009. Figure 11 illustrates the frequency that total losses happen depending on the cause, for all vessel types above the 500 GT.

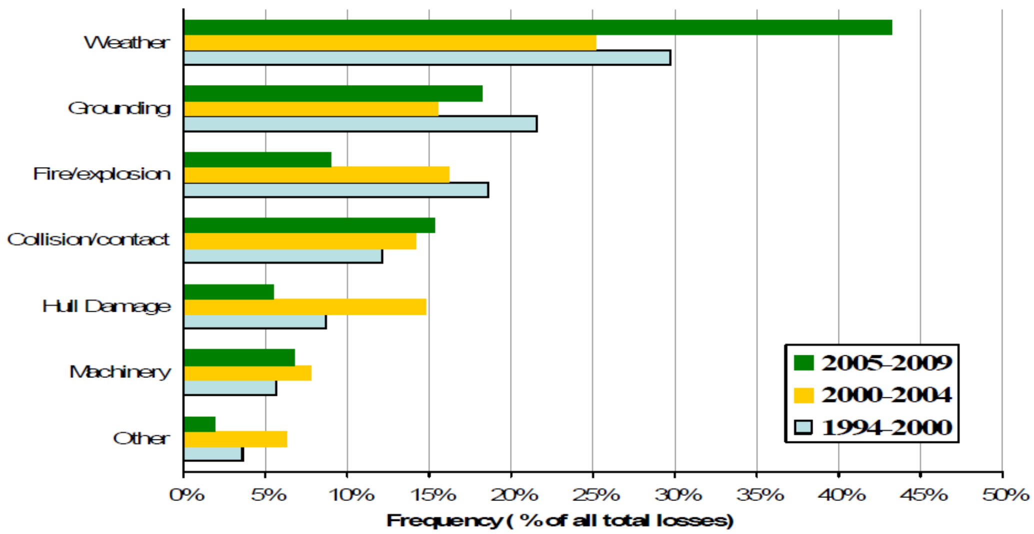

Figure 11: Total Losses 1994-2009, by cause, for all vessels > 500 GT.
Source: Graham (2009)

In the previous paragraphs and figures it has only been discussed the concept of total loss. Even though total losses are of great significance, they take place with less frequency than the major serious losses.

According to IUMI (2010), the number of major partial losses that took place in 2009 ascended to 627, which together with 2006 has presented a significantly higher frequency than the preceding years; this can be seen in figure 12.

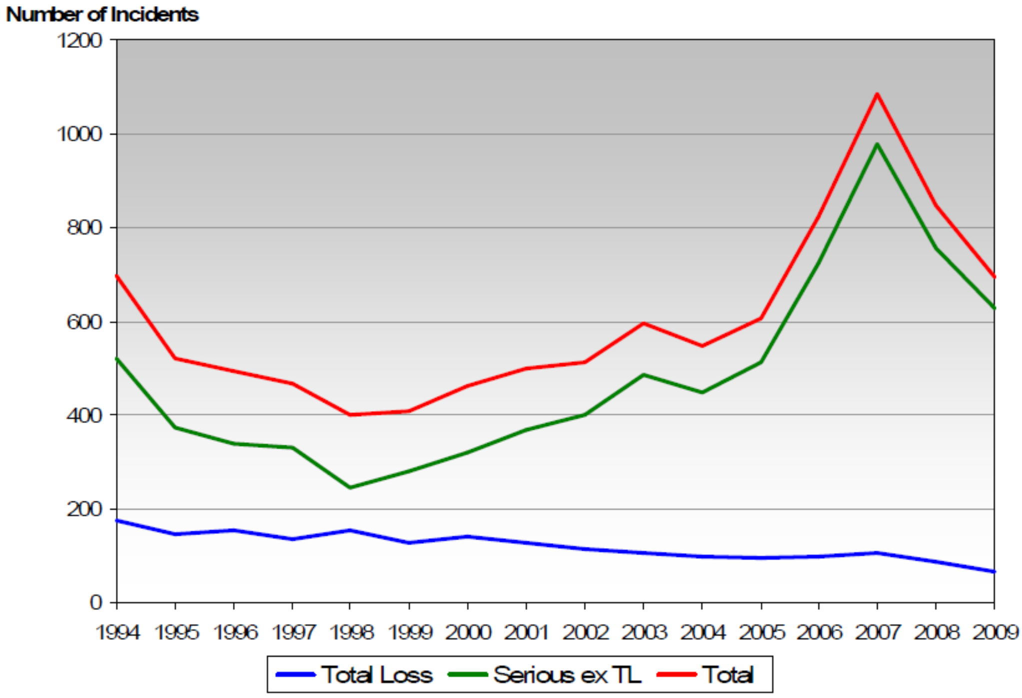

Figure 12: Total-Serious Losses 1994-2009, by number, all vessels > 500 GT. Source: Graham (2009)

From the type of accident perspective, the panorama is also very different. In the case of serious losses, accidents deriving from machinery failure are the main type, accounting for 35.21% of the total between 2005 and 2009. The second most representative type is collisions/contact with 23.13% and in third place is grounding with 21.94%. Weather conditions are of little influence for serious partial losses, with less than 5%, very different from what is was seen for total losses (IUMI 2010). In figure 13 this distribution can be better appreciated.

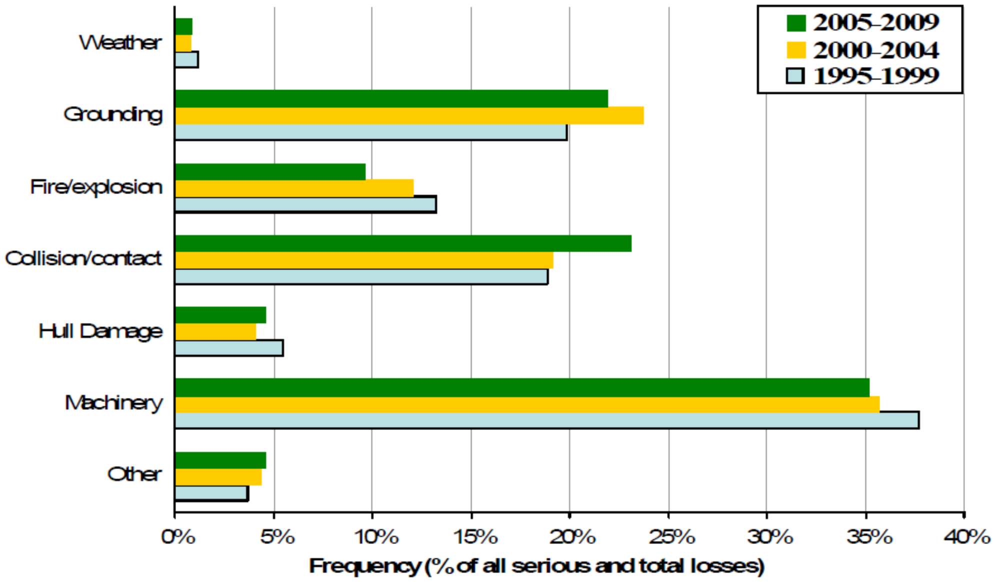

Figure 13: Serious Losses 1994-2009, by type of accident, all vessels > 500 GT. Source: Graham (2009)

In summary, this chapter has offered the foundations to understand how damages are caused and the significance of accidents and losses in the market sector that applies to the type of vessels managed THLE.

Chapter 4 Marine Accident Investigation

4.1 Introduction

This chapter is dedicated to Marine Accident Investigation. It gives an explanation of what accident investigation is, and in the case of marine accidents, which are the entities in charge of conducting such investigations.

Since the main objective of any investigation is to find out the main cause of the accident, the Root Cause Analysis is introduced.

This Analysis is described, by giving the reason why it should be done, the objective of doing it, the process to be followed and briefly describes different methods of cause analysis that can be used.

4.2 Marine Accident Investigation

Throughout the years maritime safety has improved by learning from experience. The practices and rules for shipping have been modified after catastrophic accidents have taken place. Some examples are (Heikkilä 2006):

After the HMS Captain in 1870, attention was paid to the importance of stability width and freeboard. From the Titanic in 1912 came the first Safety of Life at Sea (SOLAS) treaty and regulations concerning number of lifeboats. Due to the Morro Castle in 1934 and the Lakonia in 1963, fire safety rules where developed. The International Safety Management (ISM) code and the safety management system came out after the Herald of Free Enterprise in 1987. Double hull regulation appeared after the environmental disaster of the Exxon Valdez in 1989.

These types of accidents, which resulted in major losses of lives, assets and/or environmental disasters, are investigated by international organizations. The statutory obligation to investigate marine casualties is contemplated in the main International Maritime Organization (IMO)/International Labour Organization (ILO) conventions. For instance, the IMO Code for the investigation of marine casualties and incidents is widely applied in accident investigations although the code is only a recommendation (Heikkilä 2006).

The European Maritime Safety Agency (EMSA) is in charge of gathering and analyzing accident statistics in the European waters. All the information is stored in the European Marine Casualty Information Platform (EMCIP) whose communication structure in general terms is represented in figure 13.

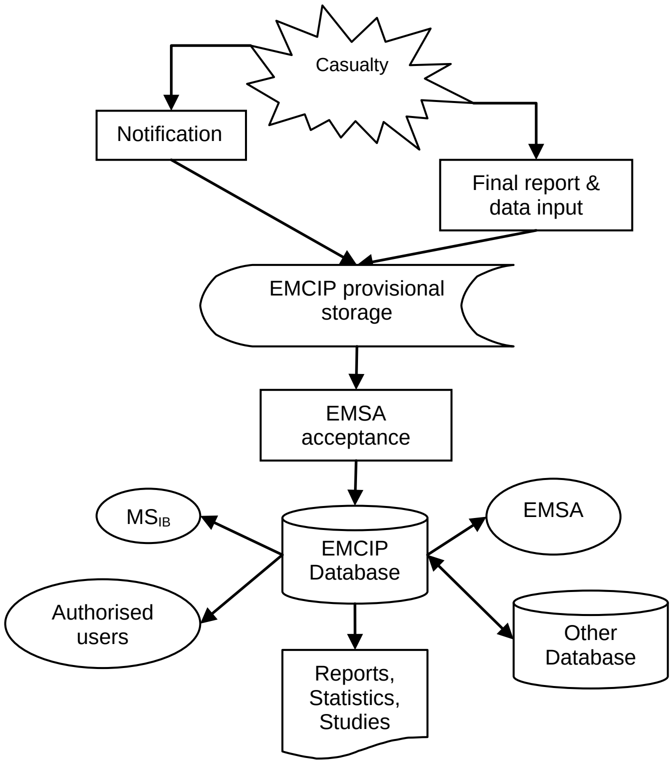

Figure 14: EMCIP Communication Structure
Source: EMSA (2010)

The EMCIP database is used to store information about: casualties (very serious, serious and less serious) involving merchant ships, recreational crafts and inland waterway vessels, and occupational accidents. For each event, the database offers basic and casualty analysis data, ranging from the ship particulars to the safety recommendations. This can be achieved with the accidental event identification and reconstruction phase compiled through the identification of the accidental events, the actors involved and their interaction. The EMCIP classifies the accidental events in: environmental effect, equipment failure, hazardous materials, human error and external agent or ship (EMSA 2010).

Accident investigation forms part of the maritime safety culture with the objective of finding the answer to “Why did the accident happen?”, while focusing on three areas of investigation: technical, human factors and organizational (Heikkilä 2006).

Depending on the severity of the accident the investigation will be done by a different level of authorities; but in order to possess a safety culture, investigations and constant improvement must be performed as from the work place (where accidents happen) to the international authorities (where regulations are been drafted). Figure 15 delineates the responsible organizations in a safety culture.

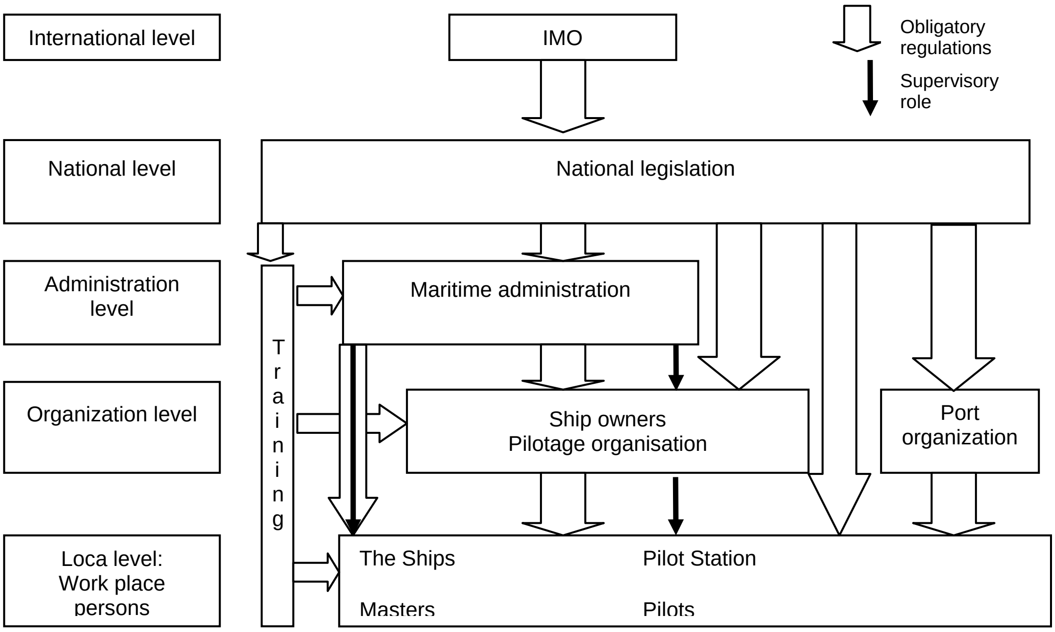

Figure 15: Responsible Organizations in a Safety Culture
Source: Heikkilä (2006)

The framework is given for accident investigation of high profile accidents that fall under international and national organizations responsibility. But what about the minor accidents that only affect a company and do not represent big threats?. These minor accidents still need to be investigated by the company itself, and that is where the Root Cause Analysis can be applied (Kingery 2005), as well as to high profile accidents.

4.3 Root Cause Analysis

Due to the implications that an accident can have, and in order to prevent future accidents by learning from experience, it is necessary to carry out an investigation and trace down the cause of the accident and the circumstances surrounding the undesired event.

But why is it necessary to carry out a Root Cause Analysis (RCA)?

According to Kingery (2005), organizations do not go far enough to expose the root cause(s) and only take actions on fixing the immediate cause ignoring to address the underlying organizational factors of a problem like lack of training, inappropriate or unfinished process and unsuitable infrastructures. Besides, root cause analysis is imperative to a good supply chain, by attacking the source of problems and in this way preventing them to disrupt the chain in the future.

Now that the reason for performing RCA is known, it is proper to explain the type of analysis this is.

Root cause analysis is a type of problem solving method with the objective of identifying the root cause of a problem or incident, rather than continue dealing with the symptoms.

This type of analysis is done under the belief that problems or incidents can be prevented and solved by correcting and eliminating the root cause (preventive measures) instead of only treating the immediately obvious symptoms (reactive measures). But in order to achieve long term results, this type of analysis should be considered as an interactive process with continuous improvement (Heikkila 2006).

In principle the RCA is a reactive measure, since an incident needs to take place before the investigation can start. According to Nielsen (2009) theory, with time and experience gathered from past investigations and incidents, the RCA can become a preventive measure able to predict possible incidents giving the time to take corrective measures before the incident can take place.

But as stated at the beginning of the previous paragraph, RCA is in fact a reactive measure, since in practice only once an incident has taken place the RCA can be performed.

According to Nielsen (2009), the root cause analysis has 5 general principles:

- The primary aim is to identify the root cause of the problem in order to take corrective actions that will prevent that problem from re-occurring.
- The RCA must be a systematic investigation, with conclusions and documented evidence of the root cause.
- There is always one or more true root cause for each problem; the difficulty is having the resilience to find it.
- The analysis must follow a timeline in order to demonstrate the clear relation between contributory factors, root cause and the problem.
- The RCA can modify a reactive culture into a preventive culture.

I believe that the last bullet point is an over estimation of what an RCA can actually do. I might help people to be more aware of their action but such a tool is not able to modify a culture by itself.

In order to achieve a systematic investigation, the RCA should try to follow a standard action process. Nielsen (2009) identifies the backbone of this process in 7 steps:

1. Identify and define the problem
2. Gather information about the problem
3. Identify the relation between the possible causes of the problem by asking “why” recursively.
4. Identify the causes that would eliminate the problem if they were removed.
5. Identify the solutions that would be the most effective at eliminating the problem without causing another one, and that are within your control.

6. Implement the solutions
7. Observe the effect of the solution and repeat the process if necessary.

In her presentation Kingery (2005) describes the root cause analysis process in a more systematic manner. Figure 16 illustrates it.

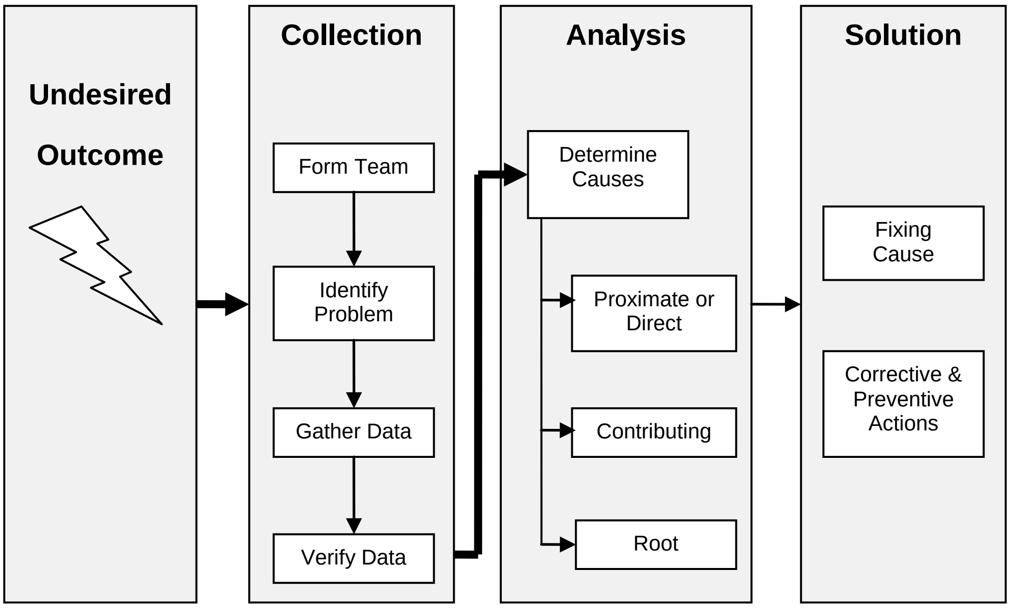

Figure 16: Root Cause Analysis Process
Source: Kingery (2005)

The undesired outcome is the answer to the question “What happened?”. For example: the vessel collided, the crane malfunctioned, a fire took place or the propeller got jammed.

This undesired outcome generates the first “Why” question or event question. It should be short, simple, concise and focus on one problem. For instance: why did the vessel collided?, why did the crane got blocked?, why did the fire started?, or why did the propeller get jammed?.

In order to answer the event question the process goes to the stage of Collection. First an investigation team is formed, with people (which can be internal or externally sourced) able to identify the problem and its causes. It should include those having a personal interest in the problem to be solved and others that can provide resource and knowledge to help in the process.

This team will identify the problem by understanding what it is and figuring out if there is more than one problem. Once it has been done, the team proceeds to the data collection. Depending on the circumstances the data may vary, but essentially it should include:

- Location (where)
- Names (who)
- Roles/functions
- Time (when)
- Conditions (operating/environmental)
- Instructions (how)
- Equipment
- Physical evidence
- Recent process changes
- Degree of training

This type of data can be gathered via photography, interviews, recording evidence and/or paper work. Finally the collection stage should end with the verification of the data in order to check the accuracy and track any conflicting information.

The Analysis stage will determine the root cause by asking the question "Why?" as many times as necessary until not been able to answer it any more. Out of this process different types of causes will arise.

The first causes that will rise up are the Proximate or Direct Causes. These first causes are the events that took place, including any conditions that triggered the undesired outcome. A second layer of causes are the Contributing Causes. They are the events or conditions that may have helped the occurrence of an undesired outcome but, if taken out of the picture or modified, would not have prevented the occurrence. At last the Root Cause will be found, which is the event or condition that led to the Direct cause and to the undesired outcome and in this case, if eliminated or modified, it would prevent the undesired outcome (Kingery 2005).

The analysis stage can have different approaches in order to reach the same goal, the root cause. The next section will address these approaches.

Finally the Solution stage can be approached. To this point the root cause has been clearly identified, but this is not enough, because now the cause has to be fixed. The solution must be appropriate for the magnitude and the risks of the problem, it should be bounded (clear identification of what will fix, clear scope of individuals/groups/projects involved and the "Why?" question should be answered), it should be well documented and implemented on time, and effective by preventing re-occurrence of the problem.

The root cause can be fixed from four perspectives. It can start by changing processes. In this case the process has to be understood by flowcharting it, clarify and restructure it, eliminate any non-value added steps, and should undergo periodic evaluation and supervision.

A second perspective is from the side of documentation and records. Procedure, specifications, handbooks and forms can be revised or new ones can be created. The third option is from the side of education and training. It can be in the form of mentoring, staff meetings, training classes and refresh courses. The last and fourth perspective is by written communications. It includes awareness and directive e-mails, public notices and bulletins; all directed to every level of the organization (Kingery 2005).

4.4 Root Cause Analysis Methods

In her article, Williams (2010) states that a RCA should be performed as soon as possible after the event, in order to prevent missing any important details. It is also stated that all the personnel involved in the event should be involved in the analysis and that way have the first hand information. Nevertheless this level of involvement may cause staff to feel hostile, defensive or apprehensive, thinking that the objective is to find someone to blame. For this reason the managers or the person in charge of the investigation needs to clearly explain beforehand that the purpose of the investigation and their presence is to focus on the settings that surrounded the event.

As mentioned before there are different methods for determining the root cause. Each one of them has its own advantages and disadvantages and will be best suitable depending on the problem or the circumstances. The methods are:

Ask why 5 times technique

It is regarded as a brainstorming method and the simplest way to perform a root cause analysis. It starts at the end result, reflects on what caused it, and asks “why” at least five times or until one can no longer answer the question. Five is just an arbitrary number, but in theory after asking five times “why” the root cause will be reached. At the end the method has produced a linear set of causal relationships and uses the experience of the problem owner to determine the root cause and corresponding solutions (Gano 2007).

According to Serrat (2009), this elementary and effective approach to problem solving promotes deep thinking through questioning, and can be adapted quickly and applied to most problems. But in order to effectively use this technique, three key elements need to be taken into account: i) accurate and complete statements of problems, ii) complete honesty in answering the questions, iii) the determination to get to the bottom of problems and resolve them. This technique was first developed by Sakishi Toyoda for the Toyota Industries Corporation. A graphic representation can be seen in figure 17.

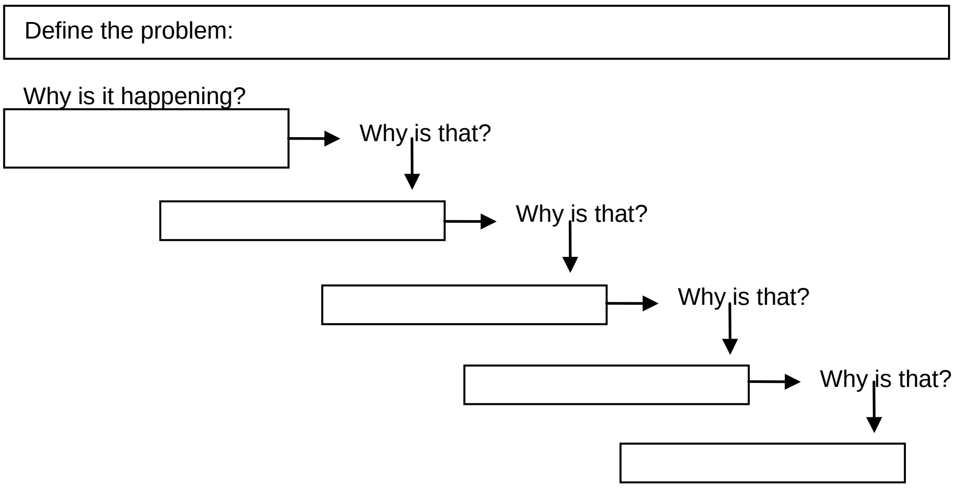

Figure 17: Five Whys Worksheet
Source: Serrat (2009)

Due to its simplicity, this technique has been criticized arguing that: investigators tend to stop at the symptoms without pursuing the lower level causes, that there is a lack of facilities and support to help ask the right questions, and that subjectivity influences the result (different investigator can find a different cause for the same problem).

Causal Tree Technique

The Causal Tree Technique, also known as the Fishbone Diagram, is used to record and display, in a logical, tree-structured hierarchy, all the actions and conditions that were necessary and sufficient for a given consequence to have occurred (Wilson 2010).

In this structure, the worst thing that happened or almost happened is placed at the top of the tree. The next step is to provide the cause for the top event, and here below the causes of the secondary causes, and continuing on until the endpoints are reached. These endpoints are the root causes. Several can be identified but the prevention efforts and possible corrective actions will be focused in the most important ones (Williams 2001).

The foundation is that every problem has causes that lie within a pre-defined set of categories. Each of these categories has sub-categories and sub-sub-categories. The use of standard categories or codes is useful for tracking and trending, that way a plot of frequency of recurring codes can be used to identify common threads that drive events (Gano 2007).

Wilson (2010) mentions the pros and cons of this technique. Some of the positive points are that: it provides a structure for recording evidence and display of what is known via the application of logic checks, gaps in knowledge can be exposed, and the structure is easy to follow. On the other hand, the negative aspects are: that it doesn't display time dependence, the endpoints can be arbitrary, and by adding complexity the difficulty increases.

Figure 18 give an idea of how a tree diagram can look like, but its complexity will depend on the circumstances and amount of predefined codes.

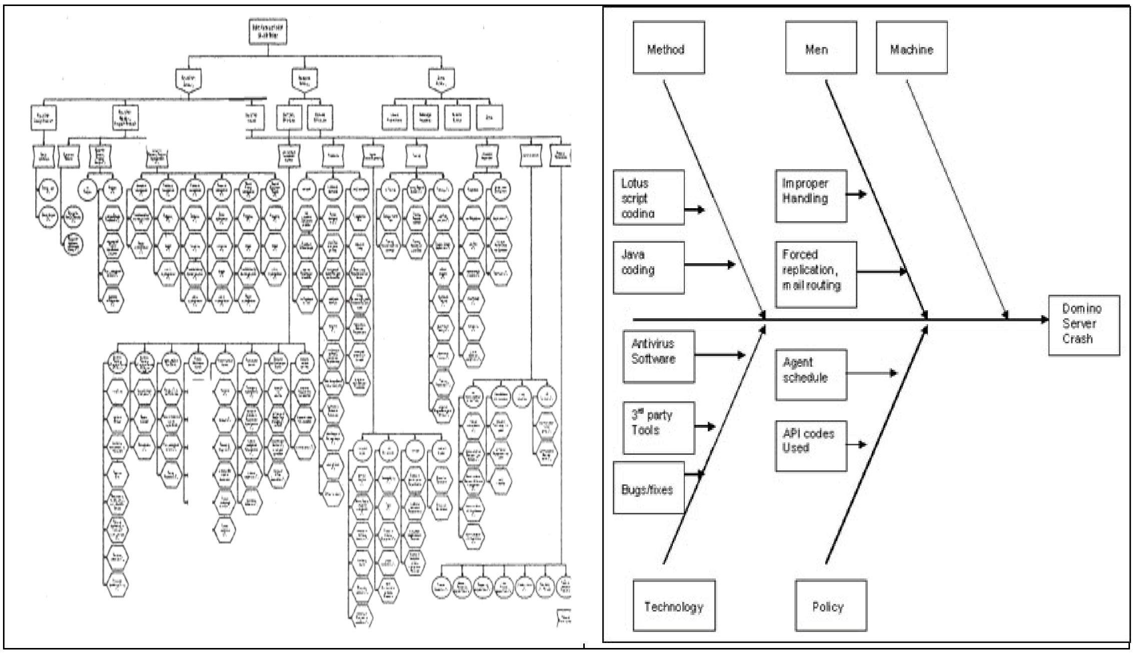

Figure 18: Tree and Fishbone Diagram
Source: Gano (2007) and Dhandapani (2004)

Storytelling Technique

This technique is described by Gano (2007) as the most common incident investigation method, also known as the fill-out-form method, which is used by nearly every business and government entity. It typically uses a predefined format that includes problem definition, a description of the event, who made a mistake, and what is going to be done to prevent recurrence.

The primary difficulties with this approach are the need to rely on the experience and judgment of the report authors and the lack of interconnection between the problem and the recommended solutions.

The main purpose of this method is to document the investigation and corrective actions via the forms, and although they do a good job of capturing the what, when and where of the event, they lack analysis of the situation.

Others

Gano (2007) mentions some other techniques, which are: Events and Causal Factors Charting and Fault Tree Analysis.

The events and causal factor charting provides the time-line that helps discover the action causes, but turns inefficient by combining storytelling with conditional causes, producing complicated relationships rather than clarity.

Fault tree analysis is not frequently useful as a root cause analysis method, because it does not work well when human actions are inserted as a cause due to the variance of possible human failure rates that prevent accurate results.

This concludes the overview on how accidents are investigated and the tools or techniques available to carry out such an investigation. The following chapter focuses on the particular case and data used for the case study subject of this thesis.

Chapter 5 Accidents Represented in the Operational Costs

5.1 Introduction

This chapter is composed mainly by two parts. In the first one, an overview is given of the standard cost structure that a shipping company might use according to the literature, emphasizing on the operational costs. These operational costs are subsequently divided, between others, into maintenance costs and insurance costs. The first ones are used to keep up to standard level the state of the vessel and that way mitigate the possibility of damages. The second one is used as part of risk management in case accidents take place.

The second part of the chapter focuses on the risk management point of view by describing the types of Insurances available in the marine market.

As it is appreciated at the end of this chapter, this thesis focus on all those damages that are covered by the Hull & Machinery Insurance, thus identifying the scope of this type of insurance is of great help.

5.2 Impact of Damages on Ship Operating Costs

Every shipping company has its own running cost classification, but according to Stopford (1997) these running costs depend on three factors. First, the *ship,* as main asset, sets the framework of cost with the fuel, crew and physical condition necessary to operate. Second, *inflation* present in the cost of bunkers, consumables, wages, repair costs and interest rates, elements subject to economic trends and outside the company control. Third, efficiently managing the company, this includes administrative overhead and operational efficiency.

Stopford (1997) continues to classify these factors into five categories:

- Operating costs: expenses incurred in the day-to-day running of the vessel. Mainly crew, stores and maintenance.
- Periodic maintenance costs: dry-docking for major repairs and for certificate purposes.
- Voyage costs: variable costs that depend on the specific voyage, which includes fuel, port charges and canal dues.
- Capital costs: represented by the means the vessel has been financed. These costs can be represented by dividends to equity and/or interests and capital payments.
- Cargo handling costs: expenses of loading, stowing and discharging cargo.

From the accident perspective, and as it has been mentioned previously, a damage can be as serious as the total loss of the vessel or as “small” as temporary impairing the value or usefulness of the vessel or part of it. Either outcome will have a financial impact on the owner of the asset, which depending on the cost structure of the company, it will be reflected in the operational costs or as a loss at the end of the financial year.

Drewry (2010) also classifies the operating costs in similar categories as Stopford, been these: manning, stores and lubricants, repairs and maintenance, insurance, dry docking and administration.

Table 2 shows the general cost classification of operational costs.

Table 2: General Cost Classification

Operational Costs	Percentage
Manning costs	32%
Stores and lubricants	11%
Repairs and maintenance	16%
Insurance	30%
Administration	12%

Source: Stopford (1997)

It is pertinent to point out that the previous cost classification has been analyzed bases on a capsize bulk carrier, and provides an indication of the role that insurance and repairs / maintenance costs play in the cost structure of a company or business unit.

5.3 Insurance

According to Stopford (1997), insurances represent 37% of the operating cost of a capsize bulk carrier, but depending on the type of vessel this percentage can vary in a range of 15 to 40 percent.

Insurance is a form of risk management that allows the ship owner to hedge against the risk of an uncertain loss by transferring the risk to a 3rd person in exchange for payment, known as the premium. The level of insurance and the premium is set by the insurance company, and is directly influenced by the performance (claims) record of the insured (owner or ship manager) and the claimed value of the vessel. A low record of accidents and claims will translate in a low premium, which is the goal of insurance companies and vessel owners. This is an incentive for vessel owners to constantly improve their working methods. In the case of SMIT, its premium is based on the value of the complete fleet of the company, the performance record, the insurance market and of course, the negotiation abilities of the people in charge of managing the companies insurances.

Given the number of parties that are involved in the shipping industry, diverse types of insurance are needed in order to have coverage against all possible risks. The main types of insurances, and the must, for any vessel are: hull and machinery (H&M) and protection and indemnity (P&I) insurance. Some other insurance could be: hull interest and freight interest, war risks and loss of hire (Cross (no date)).

The H&M insurance is regarded as the most important marine insurance and can be negotiated via a marine insurance company or broker who will in turn use a policy backed by Lloyd’s underwriters (Stopford 1997). The terms of the H&M insurance are negotiable, but according to the International Hull Clauses (JHC 2003), this insurance covers loss of or damage to the object insured, caused by:

- Perils of the seas, rivers, lakes or other navigable waters
- Fire, explosion
- Violent theft by persons from outside the vessel
- Jettison
- Piracy
- Contact with land conveyance, dock or harbor equipment or installation
- Earthquake, volcanic eruption or lightning
- Accidents in loading, discharging or shifting cargo, fuel, stores or parts
- Contact with satellites, aircrafts, helicopters or similar objects, or falling objects.
- Bursting of boilers or breakage of shafts; excluding any of the costs of repairing or replacing the boiler which burst or the shaft which breaks.
- Any latent defect in the machinery or hull, but does not cover any of the costs of correcting the latent defect
- Negligence of Master, Officers, Crew of Pilots
- Negligence of repairers or charterers provided such repairers or charterers are not an Assured under this insurance
- Barratry of Master, Officers or Crew

The previous description of causes allows having a clear idea of the type of damages this thesis will be focusing on.

In the case of the P&I insurance, this can be acquired via P&I clubs. The premium of this type of insurance not only depends on the claim record of the ship-owner, but also on other factors like the intended trading area, the cargo to be carried, the flag of registry and the nationality of the crew (Stopford 1997). This insurance covers third party liabilities and expenses arising from owning ships or operating ships as principals. The typical claims are personal injuries, oil pollution, cargo damage and losses, wreck removal, surge damage, losses to fixed and floating objects due to using the vessels anchor, mooring or towing lines, loading and discharging pipes, gangways and similar objects (Cross (no date)).

Nevertheless, UK P&I Club (2010) mentions the extent of coverage as to:

- Personal injury: illness or loss of life of crew members, stevedores, passengers and others.
- Loss of personal effects
- Diversion expenses
- Life salvage
- Collision liabilities
- Loss or damage to property other than cargo

- Pollution
- Towage contract liabilities
- Liabilities under contracts and indemnities
- Wreck liabilities
- Cargo liabilities
- Cargo's proportion of general average or salvage
- Certain expenses of salvors
- Fines
- Legal costs
- Others

5.4 Repairs and maintenance

In this case repairs and maintenance account for 12% of operational costs (Stopford 1997). These are regarded as all the measures taken to maintain the vessel to the standards set by the company, the classification society and any other regulating body who might inspect the vessel.

Repair and maintenance costs are mainly subdivided in two categories (Stopford 1997):

- Routine maintenance: of main engines, auxiliary equipment, painting of superstructure and steel renewal works possible while at sea.
- Breakdowns: mainly mechanical failures not involving the cost covered by the routine maintenance.

Having described the most significant operational costs and the coverage of the main types of marine insurance, it is time to remember, that this thesis focuses on the events, suffered by the vessels under the ownership of the business unit SMIT Transport & Heavy Lift Europe, that resulted in damages and that are covered by the H&M insurance.

Chapter 6 Data Collection and Analysis

6.1 Introduction

In this chapter the source and the process followed to collect the data used for analysis is carefully described. This thesis is based on two sources of information or databases, one produced by the MARS system and the other one by the Insurance Department of SMIT.

After this description the chapter continues in two sections. The first part is the analysis of the data derived from the MARS system. Here the answer to the main research question is developed.

The following part of the chapter examines the second database composed of the claimable and non-claimable events; which gives answer to the first two secondary research questions.

6.2 Data Collection

In the first chapter of this thesis, the research questions where formulated, and by means of a broad database and analysis of the information contained in it, these questions are answered in this chapter.

The main research question is:

> “What are the causes of marine accidents, which have resulted in damages, suffered by assets (vessels), belonging to SMIT Transport & Heavy Lift Europe?”

This question can be segmented in three parts. Chapter 2 has outlined the profile of the business unit of THLE, and the type of assets (vessels) subject to damages and the focus of this thesis. The second part of the question has been explained in chapter 3 by clearly defining the word “damage” and what it entails. Finally, the first part of the question, the causes of marine accidents, was introduced in chapters 3 and 4. Here four versions of causes of accidents where discussed, as well as the techniques to find out the direct/proximate cause, the contributing cause and the root cause. Due to reasons before mentioned and that are explained in the following paragraphs, this thesis is has found the Direct Cause of marine accidents that resulted in damages to the assets belonging to SMIT Transport & Heavy Lift Europe.

As mentioned in chapter 2, SMIT makes use of an Structured Query Language (SQL) database called Management of Accidents & Registration System (MARS) to record and maintain the information regarding all the events that have resulted in an incident, the claims and the follow up actions of those events. The system assigns an event number to each entry. This is the source of the information to be analyzed.

When trying to transfer the information of the MARS system into a software program that allowed editing the information (for example: Microsoft Word or Excel), I encountered a setback, since the settings of the system do not offer this option. At that moment it was necessary to contact the system manager and request him for such a report.

The report provided by the system manager, included all the events which had resulted in damages, was received in an Excel sheet that consisted of 2.267 event numbers. In order to retrieve the information relevant for this study, three sets of automatic filters where applied. The first filter selected only the events corresponding to the Division of Transport &Heavy Lift, this corresponded to 1.214 event numbers. A second filter selected only the events reported by the Operating Units of Transport & Heavy Lift Europe, this equaled to 403 event numbers.

The last filter left only the events that took place between the 1st of January 2005 and the 30th of June 2010, leaving a total number of 282 event numbers. This period of time was selected due to the particular interest of SMIT and the quality of the information available.

At this point it was noted that some event numbers repeated themselves. After reading through them, it was clear that the reason for this was that in the MARS system an event number can have more than one type of accident connected to it. For example: The event could have resulted in an injury, damage to the vessel and some type of environmental pollution. Since it included damage, the event number was included in the report and appeared in it three (3) times with the same event number.

Once all the repeated event numbers where indentified, the accidents that did not correspond to damages where filtering out manually, the list was left with 259 event numbers.

After going through each one of the remaining events, it was possible to clean even more the list, by filtering out the events that actually did not represent a damage to one of SMIT's assets. This resulted on the final list composed by 239 event numbers. From here onward the analysis were done based on these 239 events. Table 3 gives an overview of the filtering process previously described.

Table 3: Filtering steps of the MARS database

Description	**Amount of Event Numbers**
Initial report: events catalogued as damages for all SMIT divisions	2267
Division: Transport & Heavy Lift	1214
Operating unit: Transport & Heavy Lift Europe	403
Period of time: 01.01.2005 – 30.06.2010	282
After merging repeated event numbers	259
Only damages to SMIT's assets	239

Source: Own elaboration

This final list was also used to answer one of the secondary research questions:

> "Are there any factors that this business unit should take into account in order to improve its performance and reduce the amount of damages?"

By means of statistical analysis, trends and associations between information were obtained. These will be showed in the next section.

In order to answer the other two secondary questions:

"To what proportion are damages claimed to the insurance company?
and
What is the financial impact of the claims for the SMIT Transport & Heavy Lift business unit?"

a second database was used. This second database is managed by the Insurance Department and the information is recorded in various Excel files, per years. Each one of the files contains the information regarding the Hull & Machinery claimable and non claimable of all SMIT's divisions.

As with the damage database, the excel files corresponding to the years 2005 until 2010 (6 files in total) where the focus of attention. This was done according to the particular interest of SMIT in this period and the quality of the information available. The six files where merged into one, resulting in a list of 204 entries. In this case, only two sets of filtering were needed, since the time period was already taken into account. The first filter selected the events of the Division Transport & Heavy Lift, leaving 77 events. The second filter selected the events of the Operating unit of Transport & Heavy Lift Europe, giving a final result of 53 events.

Table 4 shows the filtering process previously described and the analysis carried out in the next section, in order to answer the two secondary research questions, is based on these final 53 entries.

Table 4: Filtering steps of the Insurance database

Description	Amount of Event
2005-2010 H&M claimable and non-claimable for all SMIT divisions	204
Division: Transport & Heavy Lift	77
Operating unit: Transport & Heavy Lift Europe	53

Source: Own elaboration

The following section will describe the trends and associations between information that were obtained by means of statistical analysis.

6.3 Analysis of the Damages Database

As mentioned in the previous section, by analyzing and handling the information included in the final two databases, it was possible to find the answer to the research questions.

The analysis will begin by identifying any trends or relations between information.

First of all, the amount of damages per year was identified. Figure 19 shows the distribution of the 239 damages during the last 5 years. At first sight there is no clear tendency besides having high amounts of damages for two years in a row, followed by a year of decreasing amounts.

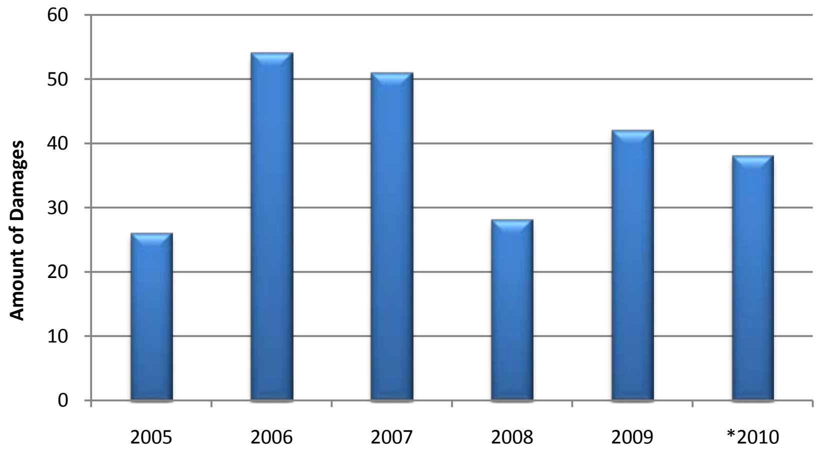

Figure 19: Amount of Damages Reported per Year (*until 30 June)
Source: Own elaboration

But this is just a superficial conclusion from the figure since five years is not enough to show a business cycle trend. In order to find if the amount of damages per year is influenced by an external variable, like the business cycle, a correlation analysis was applied. For the purpose of this analysis, the business cycle was calculated with two variables. The fist variable used was a macroeconomic variable, the annual GDP of the European Union (Eurostat 20010). The reason for choosing this variable is due to the fact that the main market of the business unit been studied is in fact the European countries, as it was described in chapter 2.

The second variable was a microeconomic variable, focusing on the internal performance of the business unit in question. For this, the year turnover of the business unit was applied.

Two other variables were contemplated. The Dow Jones Industrial Average as a macroeconomic variable and, as suggested by SMIT, the annual occupancy rate of the vessels which indicates how many days per year the vessels are actually operating under a contract, as a microeconomic variable.

The coefficient of correlation between the Dow Jones and the amount of damages was -0.00171 indicating no linear relationship (Dow Jones Average 2010), this can be seen in figure 20. As for the occupancy rate, unfortunaly do to system problems that were not resolved before finishing this thesis, this information was not available.

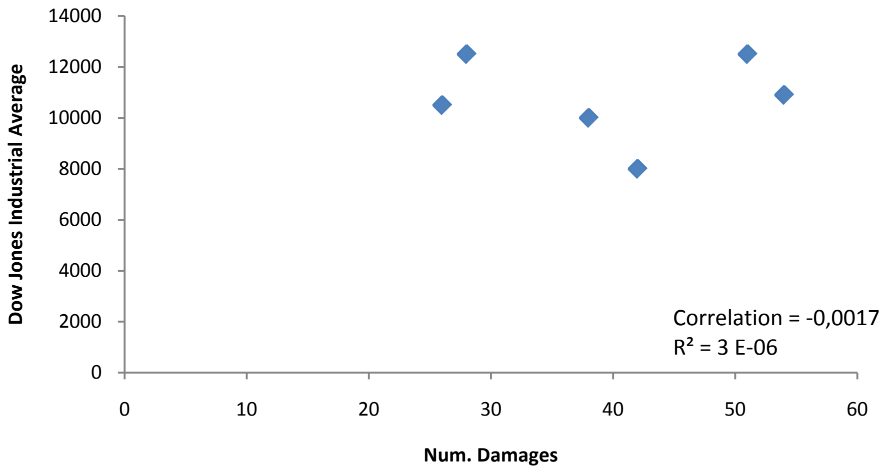

Figure 20: Relation between Number of Damages Reported and Dow Jones Industrial Average
Source: Own elaboration

In the following figures the correlation analysis between the number of damages and the EU 27 and the turnover can be appreciated.

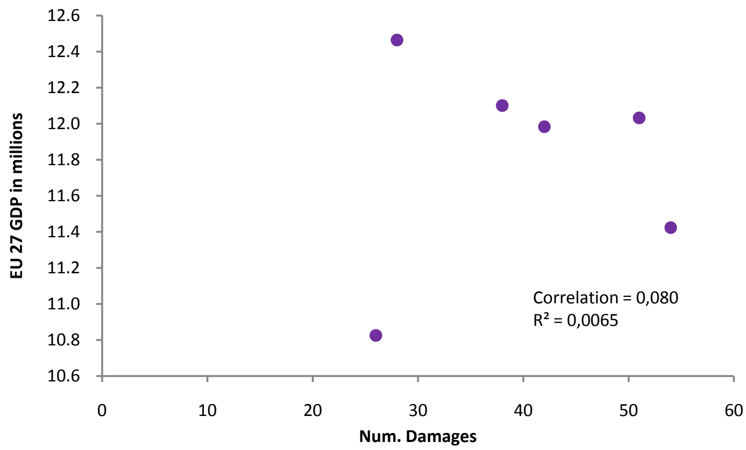

Figure 21: Relationship between Number of Damages Reported and EU 27 GDP
Source: Own elaboration

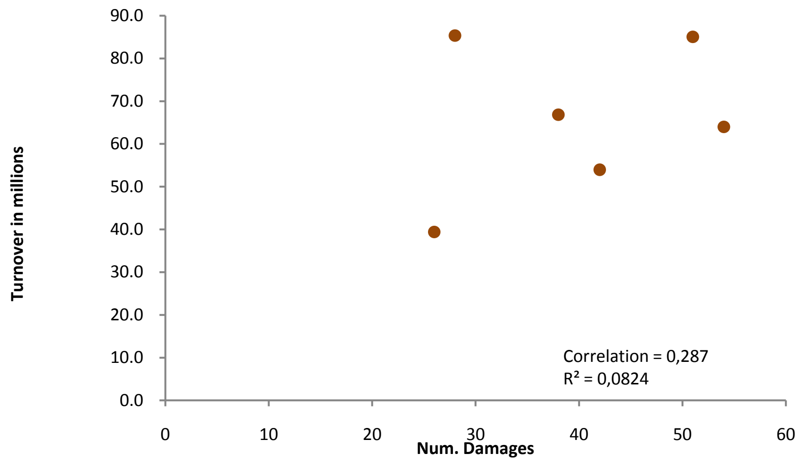

Figure 22: Relationship between Number of Damages Reported and SMIT's T&HL Eu Turnover
Source: Own elaboration

From observing figure 21 and 22 it can be said that the number of damages has no relationship with the European 27 economic output, and a very weak relation with the turnover of the business unit. At this point, and with the information available at the moment, it can be concluded that damages continue been an unforeseen event that depends on too many variables at the same time and thus difficult to attribute any influence to a specific set of variables.

A second analysis of the amount of damages was done by months. Figure 23 not only shows the amounts of damages per month in each year since 2005, but also the accumulated of the month for all 5 years.

In aggregated terms, during the months of May and June the amounts of damages have peaked. The May peak, is explained by the two sub-peaks of 2009 and 2010, which make 64% of all the damages of the month. In the case of the June peak, it is explained by the sub-peak of 2006, representing 34% of the damages of the month.

These two months are followed by January and March; the first one due to damages suffered in 2006 and the second one during 2010. During the other eight months, a steadier tendency is observed around 15 damages in average per month.

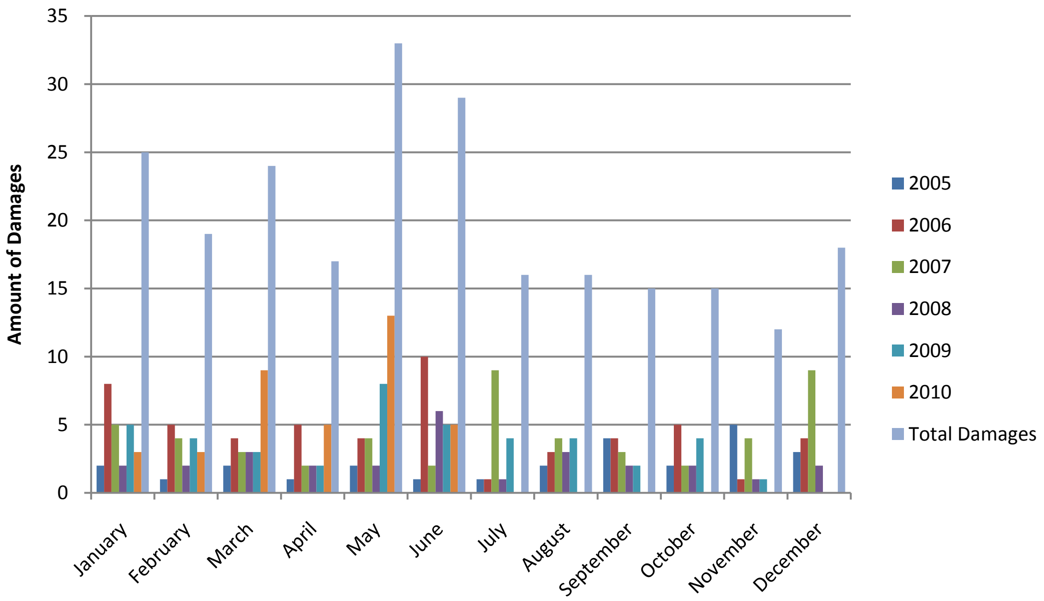

Figure 23: Amount of Damages Reported per Month
Source: Own Elaboration

In conclusion it can be said that the amount of damages have seasonal periods. During the months of winter it becomes difficult to work in the North Sea area, thus some projects accumulate and start with the offshore season in April. Thus during the months of May and June the vessels experiment a period of high levels of work under pressure, which starts decreasing during the second half of the year.

A third analysis of the amount of damages was done looking at the percentage of occurrence by vessel type. This distribution can be appreciated in figure 24.

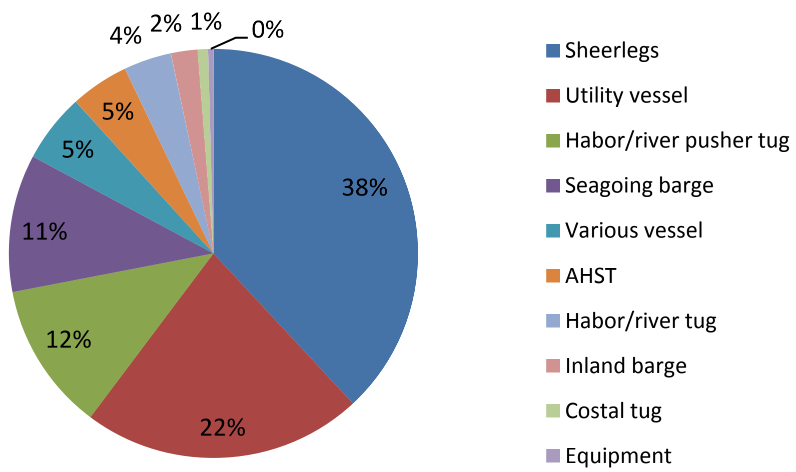

Figure 24: Percentage of Damages Reported per Type of Vessel
Source: Own elaboration

It is clear that the sheerlegs, the utility vessels and the harbor/river pusher tugs suffer more than 70% of the damages.

The next analysis was done for damages per vessel. During the period of time studied 42 vessels, out of the complete fleet, suffered one or more damages. Given the fact that during this period of time the fleet composition has changed, this analysis was based on the vessels currently in the fleet (table 1), leaving 34 vessels. From these, 9 vessels have reported an average of more than 1 damage per year in the last five years. Figure 25 presents these vessels and the amount of damages they have reported since 2005 and until mid 2010.

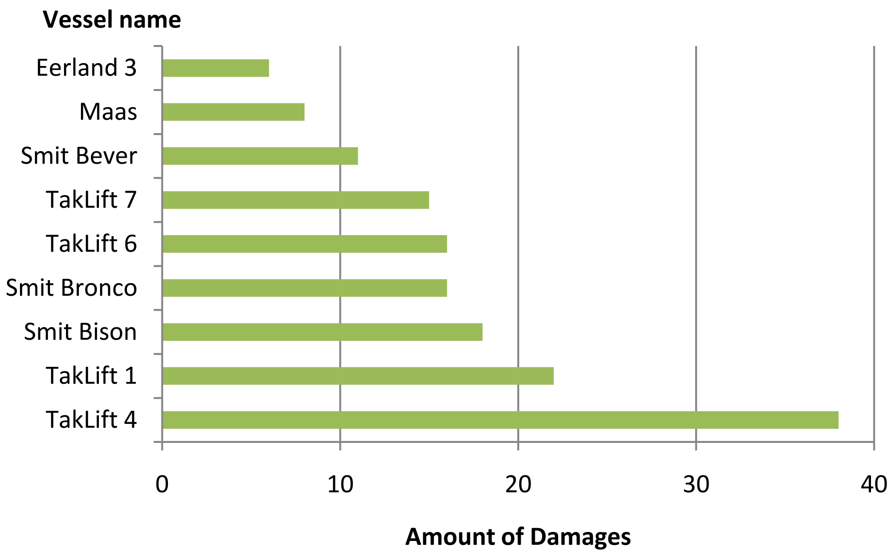

Figure 25: Amount of Damages Reported per Vessel (more than 5 damages in the last 5 years)
Source: Own elaboration

In an attempt to justify the amount of damages suffered by these nine vessels, it was contemplated that the age of each vessel could influence the amount of damages. In order to prove this theory, a correlation analysis between amount of damages and the age of the vessel was done. The theory was proven to be incorrect and the age of the vessel is of little influence since the coefficient of correlation is 0.083 which indicates no linear relations. The above can be appreciated in figure 26.

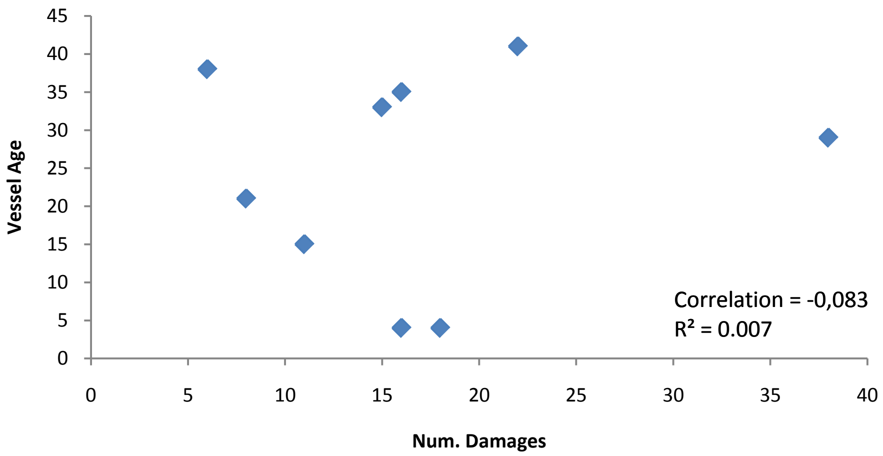

Figure 26: Relationship between Number of Damages Reported and Vessel Age
Source: Own elaboration

Another analysis was done according to the location of the vessel the moment the damage took place, which can be seen in figure 27. Keeping in mind that this study has been carried out on the business unit of THLE, whose main operations take place in European countries, it is logical to find that most of the damages took place while the vessel was in this continent, but a differentiation between countries was made. Thus the information shows that the Netherlands and the UK represent almost 50%. The before mentioned is no surprise, but what is worth mentioning is the 7% of events that are Unknown. Once we look into these particular events it came to my attention that they are due to errors in filling the form used to report damages and/or in the process of feeding the MARS system.

This finding lead to the need of checking the quality of information registered and it concluded that a full review of the registration process should be carried out.

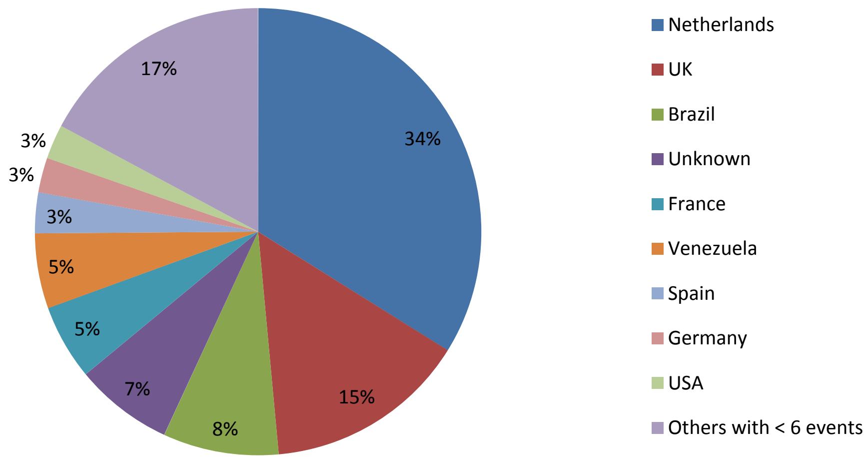

Figure 27: Percentage of Damages Reported per Country
Source: Own elaboration

If the location of the vessel, at the moment the damage took place, is categorized by continent, the distribution can be appreciated in table 5.

Table 5: Percentage Distribution of Damages Reported per Continent

Continent	Percentage of events
Europe	69%
Americas	18%
Africa	2%
Middle East	2%
Asia	2%
Others	7%

Source: Own elaboration

Finally, and in order to answer the main research question, the description of the 239 events had to be read in order to identify the cause of the accident.

As it was explained in the previous chapter, the ideal scenario is to be able to define the Root Cause, which is done by carrying out an investigation as soon as possible after the event has taken place. Out of the techniques also described in the previous chapter, it was identified that SMIT makes use of the Storytelling Technique, by which the information is recorded in paper form and once it has reached the main office it is inserted into the MARS system, as well as any other information resulting from the due investigation.

Even though the MARS system offers the option of awarding each event three different causes, identified as “General Fail Type 1, 2 and 3”, it was not possible to use that information in this study. There were several reasons for these; first of all, a small percentage of the events had any information in the field called “General Fail Type”. Second, the MARS system offers eleven options to choose from for each

“General Fail Type”, and as it was mentioned in previous chapter and proven in practice in this thesis, it becomes very difficult to assign one cause to an event when having too many sources to select from.

Thus, for standardization reasons it was decided to use the hereunder classification that takes into account the MARS system classification and the categorization used in the Marinco Survey B.V. (2002). Even though there are only five categories to decide from, the selection of one of them is subject to interpretation of the available information. For this reason the five types of Direct Causes are briefly defined in order to minimize subjectivity:

- Administrative Failure: lack of proper or complete planning, procedure or policy.
- Operational Failure: breakdown of equipment, machinery, systems or operations due to human wrong actions.
- Technical Failure: temporary or permanent malfunction of machinery, equipment or systems of the vessel.
- Environment Factors: takes into account any factor caused, aided or triggered by the environment. For example: wind, tide, swell, weather conditions, etc.
- External Factors: includes anything out of SMIT´s control and excludes the environment. For example: object floating in the water, incidents caused by third persons or vessels, etc.

Given the previous, to each event a Direct Cause was assigned, and the following figure shows the percentage of damages per Direct Cause.

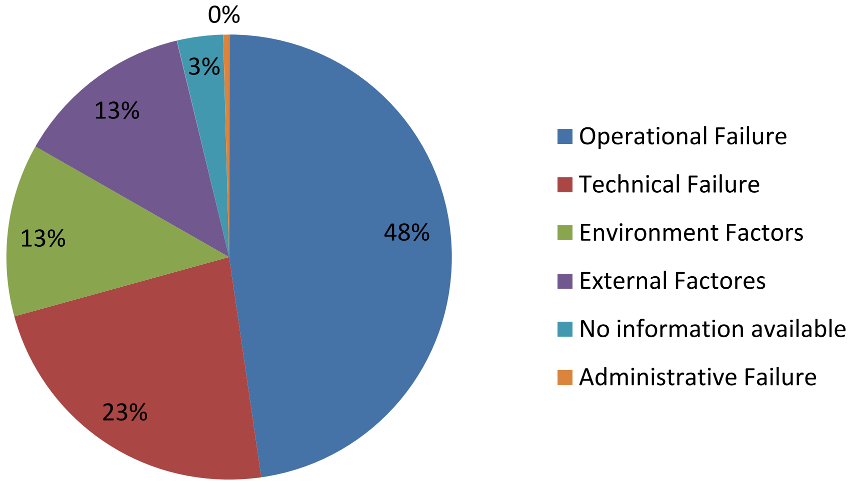

Figure 28: Percentage of Damages Reported per Direct Cause
Source: Own elaboration

Figure 28 shows that operational and technical failures are the top 2 direct causes causing 71% of the damages.

With regard to operational failure, 44% was cause by collisions or groundings and 36% due to mistakes during diverse working activities. Regarding the technical failures, 29% was due to malfunctioning of one of the hoisting equipments, while 27% was due to failure in the engines, generators or a part of them.

From a different angle, figure 29 aggregates the information from two previous figures (24 and 28). Here it is illustrated the amount of events that have resulted in damages not only per type of vessel but also per direct cause.

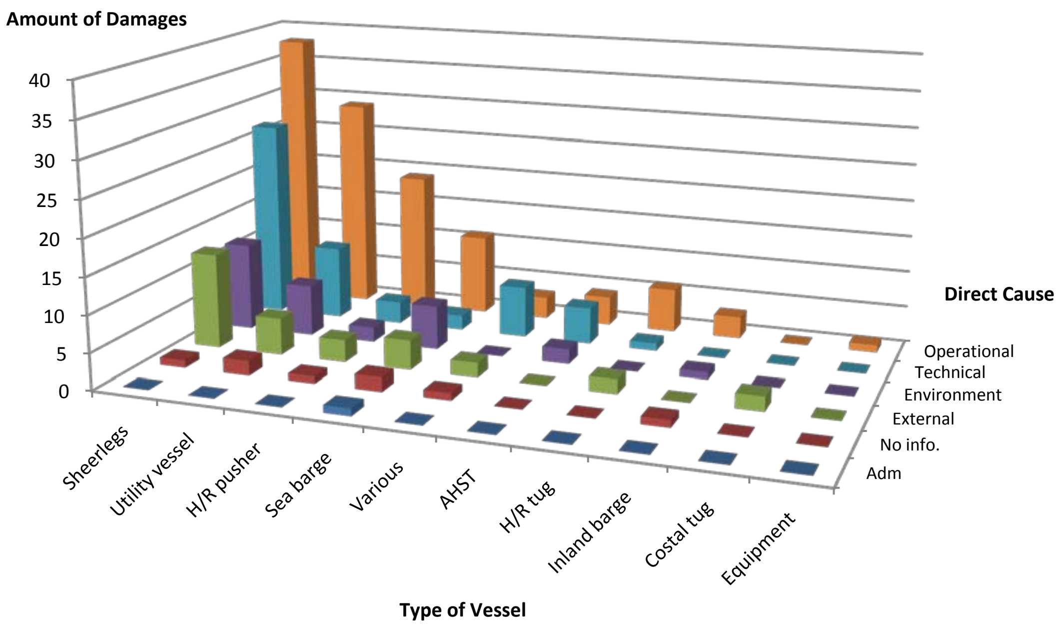

Figure 29: Amount of Damages Reported per Direct Cause and Type of Vessel
Source: Own elaboration

It is clear that the sheerlegs suffer the most amount of damages but also that these are mostly directly caused by operational and technical failures. Second place is for the utility vessels, been operational failure the most common direct cause.

6.4 Analysis of the Claimable and Non-Claimable Database

After the analysis of all the damages in general, it is time to focus on the damages that have been reported to the H&M insurance broker as claimable or non-claimable here we are focusing on 53 events.

First of all it is necessary to explain the reason of the substantial difference between the amount of damages reported in MARS and the amount of damages reported to the insurance broker. As mentioned before, every accident that has resulted in damage, no matter the type, the severity or the possible value of repairing it, is registered in the MARS system. On the other hand, the insurance department of SMIT, only registers in their excel files the damages that: i) are legitimate for an insurance claim, ii) the repair value is estimated to be more than €10.000, and iii) the repair cost were assumed by a third party. Even though this is the standard, to every rule there is an exception, and some damages with a lower value could be included, but this is subject to the particular needs of each department.

For explanation purposes it is also useful to know the difference between the claimable and the non-claimable damages. SMIT has agreed with their broker that all the H&M insurances will have a premium of €100.000. Given this, any claim worth more than the premium is claimable and if the value is less than the premium the it is non-claimable. The reason the insurance department registers both, is that by analyzing the trend from one year to another, they could see the opportunity to renegotiate the premium level with the broker.

Having cleared this up, the analysis to the insurance database can continue, starting with figure 30. This figure shows 4 different variables at the same time. The left axis together with the three lines represent amount in Euros per year of claimable and non-claimable expenses. These expenses are represented in three ways: i) completely on SMITS account (non-claimable and premiums), ii) assumed by the insurance, and iii) the gross amount of the claim. In order to put this amounts into perspective, the right axis and the columns represent the amount of claimable and non-claimable events per year.

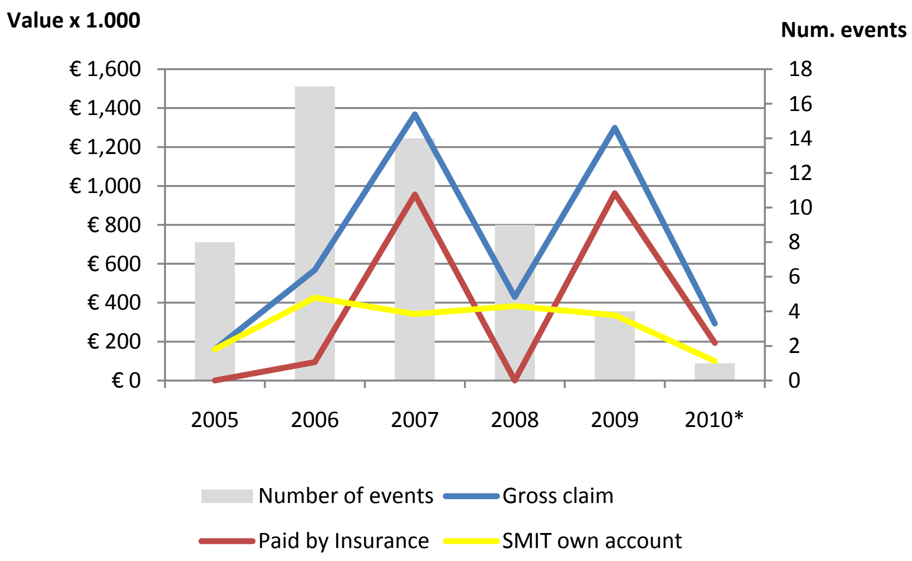

Figure 30: Value of H&M Claims per Year (*until 30 of June)
Source: Own elaboration

In 2005 and 2008 all of the damages had a value of less than the premium, except of one in 2008 which claim was withdraw and thus the year expenses where completely assumed by SMIT. In the case of 2006, one event was claimable while the costs of the other events where entirely assumed by the company. The year 2007 was a different story. From the 5 years been analyzed it was the second with the highest amount of events reported, but it was due to two events that the gross claim value was so high and that the insurance company assumed more costs than SMIT. Curiously 2009 was one of the years with the lowest amount of reported events but a peak regarding gross claim amount. This year reported 4 events, where 3 where claimable and one of them was valued in almost €800.000.

Generally speaking, during the past five years, SMIT has assumed claim costs of around €400.000 per year, which represents on average 8% of the available budget for maintenance and repairs, but it is regarded as an unforeseen event with no provisions available to cover it, and is booked as a loss in the Profit and Loss Account.

Figure 31 shows the gross claims from another perspective. Here the total of claimable/non-claimable and gross value per vessel, since 2005, is displayed.

From the figure it is obvious that there is a relation between the amount of claims and the gross value of the claims. But in the case of the vessel TakLift 7, which has the highest gross value of claims, it would be expected to have the highest number of claims, but this is not the case. The reason for this is that due to the variance in the severity and the costs that a damage can generate, for example vessel 1 can have many minor damages with low costs while vessel 2 can have only one damage which repair cost can be greater than the sum of the repair cost of vessel 1.

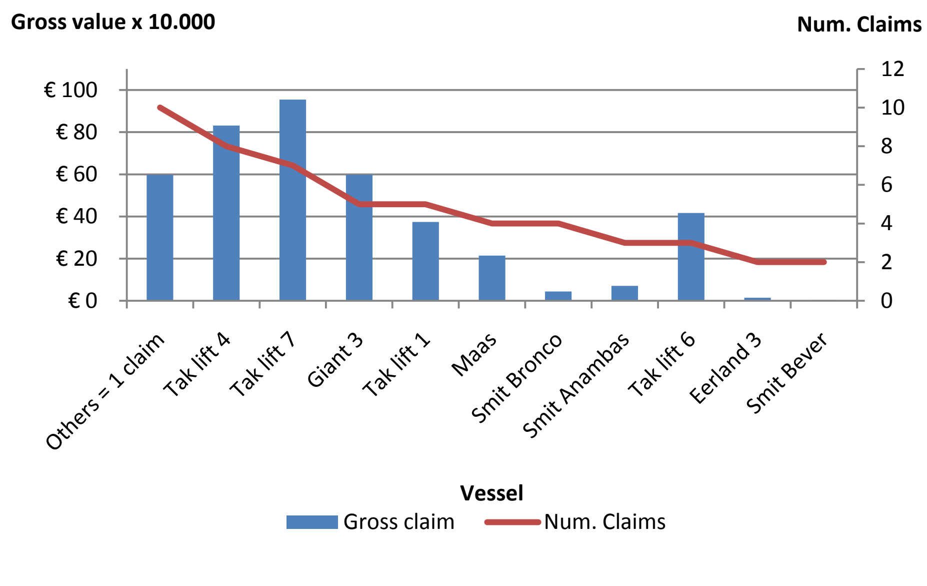

Figure 31: Gross Value of Claims per Vessel (years between 2005 and 2010)
Source: Own elaboration

Still for confirmation purposes, a correlation analysis has been done, resulting in a coefficient of correlation of 0.79. This indicates a positive linear relationship between the number of claims and the gross value of the claims. Also the coefficient of determination was calculated, been 0.62, indicating that 62% of the variation in gross value of the claims is explained by the number of actual claims. The previous can be appreciated in figure 32 and 33.

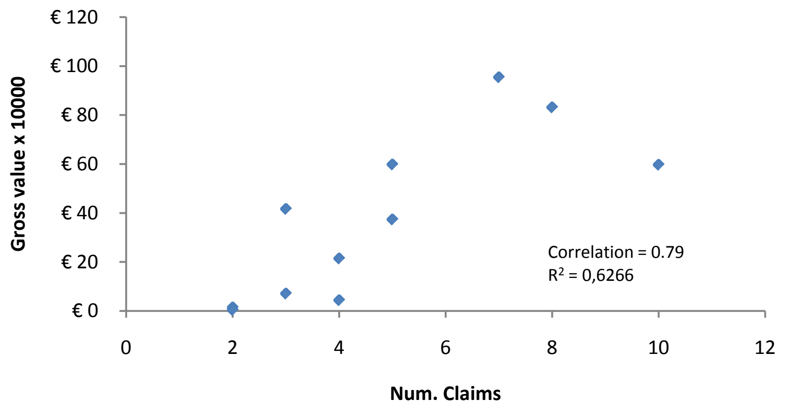

Figure 32: Relationship between Number of Claims and Gross Value of Claims
Source: Own elaboration

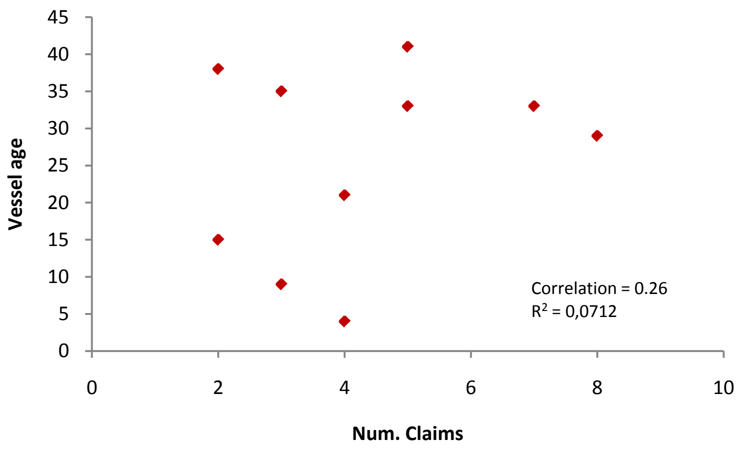

Figure 33: Relationship between Number of Claims and Vessel Age
Source: Own elaboration

The age of the vessel is another variable that was compared against the number of claims the vessel had, since one could think that the older the vessel the higher the probability for it to present failures that resulted in accidents and as consequence in damages. But this was proven wrong when the coefficient of correlation turn to be 0.26 indicating a weak relation between the two variables.

The answer to the second research question is illustrated in the following figure, were the number of damages reported in the MARS system is compared with the ones registered by the Insurance department and, most important, to the ones actually claimed to the insurance company. From the information available it was found that during the period between 2005 and 2009, on average 26% of the damages reported in the MARS system where registered in the insurance department database. And out of that 26% only 20% of the events were claimed to the insurance company.

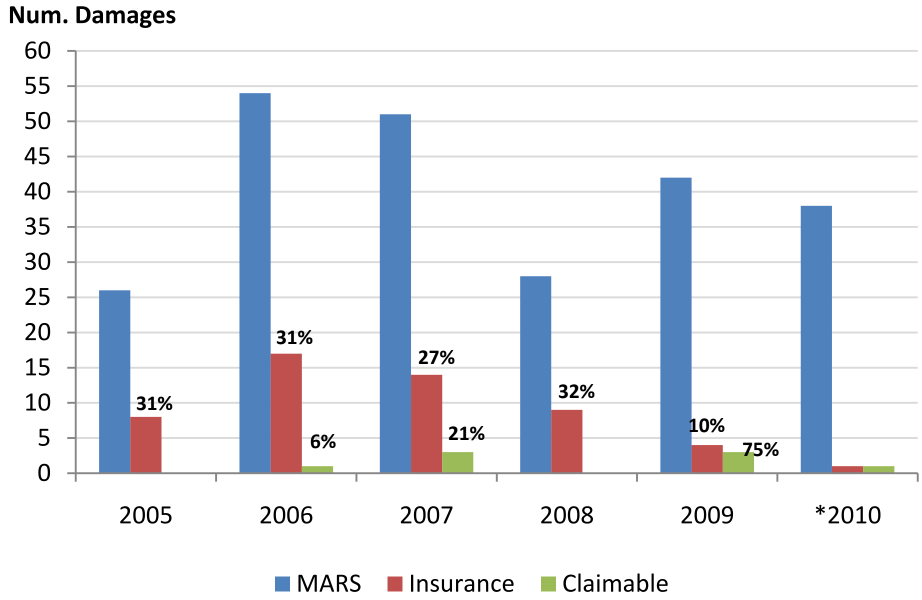

Figure 34: Number of Damages Reported per Year in the three databases.
Source: Own elaboration

This means that from the total amount of accidents that resulted in damages that have been registered in the MARS system between 2005 and 2009, only 3% had a valued of more than €100.000 and could be legitimate claimed to the insurance company.

The previous information let us approach the third research question of this thesis:

> “What is the financial impact of the claims for the SMIT Transport & Heavy Lift business unit?”

Figure 35 shows how the H&M insurance premium has changed during the last five years. As mentioned in a previous chapter this premium is set by the insurance company, and is influenced by the performance (number of claims) record of the insurer (owner or ship manager) and the claimed value of the vessel. For example if during a determined year the number and value of the claims has been low, it is most probable that the following year the premium will be lower.

Nevertheless figure 35 does not illustrate the previous logic. The reason for this is that SMIT has only one H&M insurance that covers the vessels of the different divisions, and every year the premium is influenced by the performance of the complete fleet and the negotiations between the insurance company and the insurance department of SMIT.

However each division and business unit is accountable for a percentage of the premium according to the fleet performance under their operations, and the insurance department by means of their database, modifies annually the percentage of the premium they should assume.

Figure 35: H&M Insurance Premium Development since 2005.
Source: Own elaboration

Regardless of the before mentioned it is not only on the company interest to improve its performance, but on each business unit to develop better procedures and work as a group to lower the amount of accidents and that way the probabilities of having to present claims towards the insurance company, which will result in decreases of the premium been paid by each business unit.

Chapter 7 Conclusions and Recommendations

7.1 Introduction

This chapter summarizes the findings explained in the previous chapter, bust most important it gives clear answer to the research questions that are:

1. What are the causes of marine accidents, which have resulted in damages, suffered by assets (vessels), belonging to SMIT Transport & Heavy Lift Europe?

2. To what proportion are damages claimed to the insurance company?

3. What is the financial impact of the claims for the SMIT Transport & Heavy Lift business unit?

4. Are there any factors that this business unit should take into account in order to improve its performance on reducing the amount of damages?

The chapter ends with a number of recommendations as a result of the complete process of observation and analysis of the information.

7.2 Conclusions

In this section the finding to the research questions are clearly stated, which it started by answering the first question. After the process of selection and analysis of the events that have resulted in damages, a total amount of 239 events were categorizing into one of the five direct causes. The result was that:

48% of damages are directly caused by operational failure; from which 33% take place on board of the Sheerlegs and 25% on the Utility Vessels.

23% of the damages are directly caused by technical failure. In this case almost half occur on board a Sheerleg.

13% of the damages are directly caused by environmental factors, while 13% by external factors. In both cases 40% of the damages are suffered by the Sheerlegs.

Finally, less than 1% of the damages are directly caused by administrative failure, and it is important to note that almost 3% of the events did not have enough information to be classified.

From the above it can be said that the largest proportion of damages are directly caused by operational failures, which are defined as failures during the interaction of people with equipment/machinery or during the performance of their jobs. Due to the lack of information on the persons involved in the event it was not possible to find if there is any type of relation between the amount of accidents and the composition of the crew, but since the most common cause take place on board the Sheerlegs, the composition of the crew of the sheerlegs should be the first to be analyzed and used as trial.

Now it continues to give answer to the second research question, which after comparing the total amount of events registered versus those that were claimed to the insurance company, it resulted that only 3% of the damages were claimed and covered by the H&M insurance. Given the actual amount of damages this is regarded as a low percentage, which is justified by three reasons. The first one is that the cost of repairing most of the damages is lower than the €100.000 premium, which makes it pointless to claim it, and instead run the risk of harming the track record with the insurance company. The second reason for not claiming damages is that some of the events that resulted in damage are unclear or lack documented evidence, making it difficult to legally claim the damage. The last reason is that the moment the event that resulted in damage took place, the vessel was under a charter contract and the costs of repairing the damages were paid by the client.

The third question is answered by the results of figure 35, were there is a slight confirmation that the annual premium is influenced by the amount claimed in the previous year. For example, in 2005 nothing was claimed, and the premium for 2006 was reduced 19%. On the other hand the premium increased 20% from 2007 to 2009, due to the high value of the claims that where covered by the insurance company in 2007.

However, since SMIT negotiates its premium based on the value of its complete fleet and the performance of it, the annual premium of the business unit been analyzed is influenced by this factor. Nonetheless the insurance department of SMIT, by means of tracking and registering the amount and value of the claims of each vessel, award proportionally a premium amount that each business unit should cover depending on the vessels they own and their performance. Thus it is still clear that each business unit should strive to improve their performance in order to lower the amount of damages and this way decrease their annual premium and that of the complete company.

Finally the fourth question refers to any factors or trends as a result of the analysis of the information. Figure 19 showed the distribution of the total amount of damages during the past five years, and there might be a slight indication of a two-one cycle. This means two consecutive years with higher amounts of damages followed by one year of decreasing amounts, suggesting some type of business cycle. But in order to confirm if there is actually some type of cycle, the amount of damages was correlated to two variables. The first one been the EU 27 GDP, which gave no linear correlation; and the second variable was the Turnover of the business unit, which indicates a weak linear relation. It was then concluded that the occurrence of damages depends on too many external and internal variables making it difficult to find the variables that influence these events.

When the amounts of damages were presented by month in figure 23, two picks were observed during the months of May and June. This peaks are explained by Goudriaan, D (2010, per. conv. 25 August) and due to seasonal periods. During the months of winter it becomes difficult to work in the North Sea area, thus some projects accumulate and start with the offshore season in April. Thus during the months of May and June the vessels undergo a period of high levels of work under pressure, which starts decreasing during the second half of the year. This could be easily confirmed, the same as the year information, if the amount of damages were to be correlated to the occupancy rate of the fleet, since this last variable would show how many days per year or month a vessel is been productive.

Figure 24 illustrates the percentage of damages per type of vessel, which revealed an interesting result. The sheerlegs and the utility vessels have reported 60% of the damages even though these two types of vessels have the lowest amount of units. It was then brought to my attention by Dijkshoorn, W (2010, per. conv. 25 August) the reasons for this result. First of all, due to the type of work these vessels perform, they are more susceptible to coming into contact with other vessels or structures. Second, these types of vessels are mostly hired by frequent clients who demand high performance and thus pressure the crew to report every incident. Finally and related to the previous reason, the crew onboard these types of vessels possess a work mentality based on responsibility, which translates on reporting every event that takes place.

The previous makes one realize that figure 24 should be interpreted as the percentage of damages REPORTED per type of vessel, and not suffered by type of vessel, although without further insight both perceptions should be taken into account.

One last discovery was made in figure 25, which shows nine vessels, currently in the business unit fleet, that reported more than five damages in the period between January 2005 and June 2010. Here the vessel TakLift 4 reported almost 40 damages in this period of time. According to Dijkshoorn, W (2010, per. conv. 25 August) this large amount of damages is justified by two main reasons. The first one is that this vessel was involved in the Life Time Extension Project, which required high levels of activity of the vessel, and as mentioned before, due to the type of work these vessels perform, higher risk to come in contact with other vessels or structures. The second reason was that the TakLift 4 was in dry-docking from June 2009 until March 2010, and it is know in the company that during these maintenance periods a significant amount of damages are discovered and thus reported.

7.3 Recommendations

During the period of time it took me to write this thesis, and which I expended looking at internal information and process related to the composition of the business unit fleet and the registration of events into the MARS system, I encounter situations that I humbly recommend they should be revised and/or modified, even though they are not part of my research questions.

When trying to identify the current composition of the fleet of the business unit, I was confronted with three different sources, each one of them composed by different information. The first source came from the Legal Affairs department and was reproduced from a database system called ANCHOR. The second source was from the Insurance department and is based on the vessels registered with the insurance company. The third source, and the one that was used in this thesis, was from the Vessel Surveyor report and had the highest amount of vessels. This situation gave place to confusion and until now is not clear which of the sources is the most updated. Thus, it would be recommended to select the most appropriated source and use it as the centralized database.

Once the database of the reported event that resulted in damages was defined, I proceeded to read the information available in MARS for each event, in order to classify them under one of the five direct causes of damages. During this process it came to my attention that there are some inconsistencies between the information registered and what it is been asked. Thus the process of reporting events and registering the information in the MARS system should be traced back to its origin.

Given this, I started by reviewing the SMIT Corporate Incident Reporting Form, which is available electronically to the masters of the vessels. After this, I believe that the name of the fields should be explicit and mach those available in MARS and vice versa. In order to guarantee that the form is properly filled in I suggest the following. Each one of the fields of the form should be provided with an instruction comment. For example, one of the fields is called “Place”, and the instruction comment should say “state the geographical location of the vessel at the moment the event took place”. In case the form is available in paper, these instructions should be printed out on the other side of the form. This would avoid having to instruct each Master on how to fill in the form and to eventually attend refreshment courses. Although it would be recommended to clearly inform them about these information comments.

As mentioned in the conclusions the amount of damages are most likely related to the performance of the crew. And a method to measure crew performance could be done by including a field in the reporting event form, where the names of the crew members involved in the event can be reported and registered; option that is only available for injury related events. With this information and backup by the department in charge of assigning the crew, the performance can be measured using: nationalities, level of education, level of experience, etc. If this is done, a new variable is available to find out if there are any tendencies related to the amount of damages.

Once the report has reached the main office the information is then entered in the MARS system, task that is performed by at least 5 persons in the Rotterdam office. By having so many people involved in this phase, it is very difficult to have standardized information. The information in the form is subject to interpretation and therefore can be “translated” from person to person. Also the format on introducing the information varies from one to the other, making it difficult to reproduce reports. It is thus advised that either all the persons in charge of entering the data in MARS agree on a standard and follow through, or that the amount of persons is reduced and still a standard is clearly set.

At first sight the MARS system, could offer a lot of information about an event, which is only useful if the system is properly fed and updated. But it came to my attention that most of the information I thought I could find was not filled in. This was due to two reasons. First the information was not reported in the first place and second the information is registered in another database, for example: insurance information and follow-ups and results of the accident investigation. The last reason was explained by several people and by own experience, as to the failure of the system to issue manageable reports (in word or excel format for example). Although this should be reviewed in order to have one database that includes all the information and which is able to satisfy the needs of all its users; due to the current merger process of departments and its systems, any modifications should be done once the final set up of the company is defined.

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