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"EXHAUSTIVE CHAID" ANALYSIS OF FACTORS THAT AFFECT DETENTION DURATION OF VESSELS IN PARIS MoU REGION

İSMAİL ÖLMEZ

Supervisor
Assist.Prof.Dr. Nurser GÖKDEMİR IŞIK

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Üniversite : Dokuz Eylül Üniversitesi

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Adı ve Soyadı : İSMAİL ÖLMEZ

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Danışmanı : Assist Prof.Dr.Nurser GÖKDEMİR IŞIK

JÜRİ ÜYELERİ

Ünvanı, Adı, Soyadı	Üniversitesi	İmza
Assist Prof.Dr.Nurser GÖKDEMİR IŞIK	DOKUZ EYLUL UNIVERSITY	.....
Assoc Prof.Dr.Sadık Özlen BAŞER	DOKUZ EYLUL UNIVERSITY	.....
Assoc Prof.Dr.Muhittin Hakan DEMİR	İZMİR UNIVERSITY OF ECONOMICS	.....

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I hereby declare that this master's thesis titled as ""Exhaustive CHAID" Analysis of Factors That Affect Detention Duration of Vessels in Paris MoU Region" has been written by myself in accordance with the academic rules and ethical conduct. I also declare that all materials benefited in this thesis consist of the mentioned resources in the reference list. I verify all these with my honour.

.../.../ 2017
İsmail ÖLMEZ

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ABSTRACT

Master's Thesis

"Exhaustive CHAID" Analysis of Factors That Affect Detention Duration of Vessels in Paris MoU Region

İsmail ÖLMEZ

Dokuz Eylül University

Graduate School of Social Sciences

Department of Maritime Business Administration

Maritime Business Administration Master's Program

Port State Control (PSC) is an indispensable tool for maritime law enforcement. Scope of PSC covers safety, seaworthiness, pollution prevention, on-board living and working conditions. PSC, by eliminating substandard ships; provides assurance for the standards which are set by the International Law. Paris Memorandum of Understanding (MoU) is the first regional control regime agreement. With regard to inspection efforts, Paris MoU and Tokyo MoU constitute more than half of the global PSC inspection efforts. Main instrument which used by PSC Authorities for substandard ships is a detention. Detention of a ship no doubt has negative impact to ship owner/manager and additionally other stakeholders of subjected ship. Intensity of this impact is directly related with the duration of detention. This study aims to find out which factors have effect on duration of a detention.

In this research; data of the ships which are detained in Paris MoU from January 2014 to November 2016 (35 months) are collected from Paris MoU official web site. 1829 detention occasions took place during research period. Beneficial ownership information of each ship is collected from Equasis database which is a public database funded by European Commission and French Government.

Exhaustive CHAID analysis is performed for each ship type within data set. Results of the analyses showed which factors generate variance in duration of detention. In 6 of 7 subset of data set, duration of detention varies significantly by port of inspection. Although 6 owner/managing countries dominates the detention lists, duration of detention doesn't vary by

owner/managing countries. 7 decision trees finally explained 57 % of total variance.

Key Words: Port State Control, Paris MoU, Exhaustive CHAID, Detention

ÖZET

Yüksek Lisans Tezi

Paris MoU Bölgesinde Gemilerin Alıkoyulma Sürelerini Etkileyen Faktörlerin "Detaylı CHAID" Analizi

İsmail ÖLMEZ

Dokuz Eylül Universitesi

Sosyal Bilimler Enstitüsü

Denizcilik İşletmeleri Yönetimi Anabilim Dalı

Denizcilik İşletmeleri Yönetimi Yüksek Lisans Programı

Liman Devleti Kontrolü (PSC) denizde kanun uygulamaların vazgeçilmez bir aracıdır. Liman Devleti Kontrolü emniyet, denize elverişlilik, kirlenmenin engellenmesi, gemide yaşam ve çalışma şartları konularını kapsamaktadır. Liman Devleti Kontrolü, standartaltı gemileri elemek suretiyle uluslararası hukukun belirlemiş olduğu standartlar için güvence sağlamaktadır. Paris Mutabakat Zaptı (MoU) ilk bölgesel control rejimi antlaşmasıdır. Paris MoU ve Tokyo MoU bölgelerindeki denetim gayretleri, dünya çapındaki denetim gayretlerinin yarısından fazlasını oluşturmaktadır. Liman Devleti Kontrolü Otoritelerinin standartaltı gemiler için ana yaptırım aracı gemilerin alıkoyulmasıdır. Bir geminin alıkoyulması geminin donatan/işletenleri ile birlikte diğer gemi ilgilileri açısından şüphesiz olumsuz bir etkiye sebep olmaktadır. Söz konusu olumsuz etkini boyutu doğrudan alıkoyulma süresi ile bağlantılıdır. Bu araştırma gemilerin alıkoyulma sürelerini etkileyen faktörleri tespit etmeyi amaçlamaktadır.

Araştırmada Paris MoU bölgesinde Ocak 2014-Kasım 2016 (35 ay) tarihleri arasında alıkoyulan gemilere ilişkin veriler Paris MoU'nun resmi internet sayfasından derlenmiştir. Araştırma periodunda 1829 alıkoyma olayı gerçekleşmiştir. Her geminin faydalanan maliklerine ilişkin bilgiler, Avrupa Komisyonu ve Fransız Hükümetince kurulmuş olan "Equasis" veritabanından derlenmiştir.

Veri setindeki her gemi tipi için ayrı ayrı "Detaylı CHAID" uygulanmıştır. Analiz sonuçları, hangi faktörlerin alıkoyulma süresinde varyansa sebep olduğunu göstermiştir. Veri setinin 7 alt grubundan 6'sında alıkoyulma süresinin denetimin yapıldığı limana göre anlamlı şekilde değiştiği gözlenmiştir. Alıkoyulan gemilerin çoüunluğunu, mülkiyeti aynı 6 ülkeye ait gemiler oluşturmasına karşın,

alıkoyulma süresi geminin malikinin ülkesine göre değişmediği gözlemlenmiştir. Araştırma sonucunda elde edilen 7 karar ağacı toplam varyansın yüzde 57'sini açıklamıştır.

Anahtar Kelimeler: Liman Devleti Kontrolü, Paris MoU, Detaylı CHAID, Alıkoyma

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ABBREVIATIONS

AFS	Anti-Fouling System
AID	Automatic Interaction Detection
ANOVA	Analysis of Variance
BGW-Lists	Black Grey White Lists
BSMOU	Black Sea Memorandum of Understanding
BWM	Ballast Water Management
CCS Institute	Carbon Capture and Storage Institute of Australia
CG-CVC	Coast Guard Commercial Vessel Compliance
CHAID	Chi-squared Automatic Interaction Detection
CIC	Concentrated Inspection Campaign
CLC	International Convention on Civil Liability for Oil Pollution Damage
CLS	Concept Learning System
CMOU	Caribbean Memorandum of Understanding
COLREG	International Regulations for Preventing Collisions at Sea
DWT	Dead Weight Tone
ELISEE	Exploration of Links and Inter-actions through Segmentation of an Experimental Ensemble
EMSA	European Maritime Safety Association
FOC	Flag of Convenience
FSC	Flag State Control
FSI	Flag State Inspection
GMDSS	Global Maritime Distress and Safety System
HRS	High Risk Ship
IBM	International Business Machines Incorporation
IDEA	Interactive Data Exploration and Analysis
ILO	International Labour Organization
ILO 147	Merchant Shipping (Minimum Standards) Convention
IMO	International Maritime Organization
IMSO	International Mobile Satellite Organization
IOMOU	Indian Ocean Memorandum of Understanding
ISM (Code)	International Safety Management Code
ISPS (Code)	International Ship and Port Facility Security Code

LL	International Convention on Load Lines
Ln	Natural Logarithm
LRS	Low Risk Ship
MAB	MoU Advisory Board
MAID	AID for multivariate quantitative outcome variables
MARPOL	International Convention for the Prevention of Pollution from Ships
MedMoU	Mediterranean Memorandum of Understanding
MLC 2006	Maritime Labour Convention
MoU	Memorandum of Understanding
NIR	New Inspection Regime
PROT	Protocol
PSC	Port State Control
PSCO	Port State Control Officer
PSJ	Port State Jurisdiction
RMT	Review of Maritime Transportation
RO	Recognized Organization
ROCRAM	Regional Cooperation Among Maritime Authorities of South America
Ro-Ro	Roll on - Roll off
SOLAS	International Convention for the Safety of Life at Sea
SPSS	Statistical Package for the Social Sciences (Registered Trade Mark of IBM)
SRP	Ship Risk Profile
SRS	Standard Risk Ship
STCW	International Convention on Standards of Training, Certification and Watch-keeping for Seafarers
SUA	Suppression of Unlawful Acts
THAID	THeta Automatic Interaction Detection
THETIS	Information System of European Maritime Safety Association Which Supports Paris MoU Region
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNCTAD	United Nations Conference on Trade and Development
USA	United States of America

USCG	United States Coast Guard
VLCC	Very Large Crude Carrier

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INTRODUCTION

Maritime safety has crucial importance not only for lives of seafarers but also all other stakeholders of industry from ship-owners to passengers as well as marine environment. As the number and tonnage of the global fleet grows the importance of the maritime safety grows as well. During last century several catastrophic maritime disasters such as Titanic and Torrey Canyon showed that maritime safety can't be left to the hands of eager ship owners/operators or individual states which are mostly incapable of sufficient law enforcement efforts.

The maritime industry can be considered as a heavy legal framework based on international law with limited legal enforcement possibilities in case of non-compliance. From a public viewpoint, the desired situation is to promote safe, secure and environmentally friendly maritime transportation and to decrease the number of substandard vessels. Port State Control at this point is indispensably important instrument for international law enforcement.

"Substandard ship" term is determined by IMO's guideline for PSC, according to that; "*If evident factors as a whole or individually make the ship unseaworthy and put at risk the ship or the life of persons on board or present an unreasonable threat of harm for the marine environment if it were allowed to proceed to sea, it should be regarded as a substandard ship*".

Primary tool of PSC to eliminate substandard ships is detention. The circumstances leading to a detention is defined in all MoU's and in all cases, detention is justified, if the ship is to be seen as substandard. A list of detainable deficiencies can be found in "IMO Guidelines on PSC chapter 2.3" for further reference.

Detention of a ship has a negative impact to all stakeholders of subjected ship. Desired situation for a ship owner/operator to keep his ship in internationally approved maritime safety standards. The negative impact of a detention is directly related by duration of the detention.

Turkish owned/managed ships suffers mostly from the negative impact of detentions as Turkish owned/managed ships constitute 16 percent of all detention[1] occasions within Paris MoU region. Main goal of this research is to help ship owners/operators in reducing the duration of detention by identifying which factors have effect.

This thesis consists of three chapters.

At first chapter legal framework of Port State Control, relevant International Organizations and Conventions are introduced.

At second chapter; regional PSC regimes and their efforts in PSC are summarized. Inspection policy and PSC implementation within Paris MoU region are described.

At third chapter; research question, the data set and methodology are determined. Basic statistics about detentions and deficiencies are presented. To find out interactions among "duration of detention" and other variables; "Exhaustive CHAID" analyses are performed for each ship type. As a result, analyses produced 7 decision trees which provide better knowledge about the factors which affect "duration of a detention". Analyses also explained 57 per cent of the total variance in "duration of detention" within data set.

[1] See page 65

CHAPTER 1
POLITICAL AND LEGAL EVOLUTION OF PORT STATE CONTROL

1.1. TERM OF 'PORT STATE CONTROL' (PSC)

Port State Control (PSC) is an examination of foreign vessels at domestic harbours to confirm that the situation of the vessel and its gear fulfil with the necessities of worldwide conventions and that the vessel is operated and worked in acquiescence with those guidelines. (www.imo.org)

Main concern of the PSC is to eliminate substandard ships, which are potential perils of casualties of seafarers and maritime environment.

With its origins started after big marine losses, port state control has inherited its specific as the main operative enforcement tool to eliminate the planet's harbours and waters of deficient, unsuitable to sea and unsafe vessels. (Hare, 1996,24)

1.2. HISTORICAL BACKGROUND OF PSC

Both customary and treaty-based international law entitle states to grant nationality to ships on such conditions as they may establish. However, because flags of convenience (FOC) are frequently reluctant or incapable to applicate operative regulation, numerous ships listed in aged and deficient. (Ademuni and Odeke, 1997,1)

By the late 1970s increase in numbers of ships that fly FOC call European ports. By 1978 the 'Hague Memorandum' among a quantity of marine establishments in West Europe was established. They allocated mostly with implementation of on-board accommodation and labouring environments as obligatory to ILO Convention no. 147. (www.parismou.org/About-us/History) Though while the agreement was near to become operational in March 1978 a huge petrol leak happened near of the shore of Brittany (France) consequently hitting the ground of the 'Amoco Cadiz' (Liberia flagged VLCC). (Gundlach et. All, 1983,1) That event initiated a solid governmental and civil row through Europe for stricter code of practice concerning security of shipment. That force caused a more wide-ranging agreement which included security of life at sea, prevention of toxic wastes from ships and living and labour situations on vessels. (Ibid)

As a result, bigger devotion started to topics of marine security, exercise and labour environments, and protection of the oceanic surroundings. A general consensus gradually developed that these issues could no longer be left to individual nations. (Ademuni and Odeke, 1997,2) These conditions led eight North Sea States agreeing to exchange information on foreign ships in 1978. This was superseded in January 1982 when 14 European States decided to found a coordinated organisation of examination producing in the ratification of the Paris Memorandum of Understanding (MoU) on Port State Control. Canada to the west and the Russian Federation to the east also participate as members of the Paris MoU. (INTERCARGO, 2000,7)

Özçayir remarks the roots of PSC lie beneath The Hague MoU contracted in 1978 (Özçayır, 2009,8). In other view; Kulchytskyy indicates that the roots of PSC can be found at the initial form of SOLAS, which was accepted in 1914 right after sinking of Titanic. (Kulchtiskyy, 2010,22) The initial endowment on PSC in the worldwide resolution start with the art. 61 of SOLAS 1914, that states next:

> *"Every ship holding a Safety Certificate issued by the officers of the Contracting State to which it belongs, or by persons duly authorised by that State, is subject in the ports of the other Contracting States to control by officers duly authorised by their Governments in so far as this control is directed towards verifying that there is on board a valid Safety Certificate, and, if necessary, that the conditions of the vessel's seaworthiness correspond substantially with the particulars of that certificate; that is to say, so that the ship can proceed to sea without danger to the passengers and the crew."*

After successful application of Paris MoU which is stated as an "administrative agreement" instead of a "convention", other regional control regimes have been developed. Apart from others USA has developed its own control regime. Now there are 10 regional PSC regimes globally, which consist of 9 regional PSC Memorandums of Understanding agreements and US Coast Guard PSC regime. Table 1.1 provides regional MoU's and their foundation years.

Regional MoU	Foundation Year
Paris MoU	1982
Vina del Mar MoU	1992
Tokyo MoU	1993
Caribbean MoU	1996
Mediterranean MoU	1997
Indian MoU	1998
Abuja MoU	1999
Black Sea MoU	2000
Riyadh MoU	2004

Table 1.1 Regional Memorandums of Understanding
(Source: Official Web Sites of MoU's)

1.3. STATES' RIGHT FOR REGULATION AND INSPECTION

A port is a gateway for a maritime state and all the territory of the port is under sovereignty of that respective state. On the other hand, all the ships are subject to the Flag State jurisdiction according to customary international law. Ports also provide an opportunity for verifying if visiting foreign ships comply with certain types of national or international technical standards or if they have engaged in certain illegal behaviour in the port state's maritime zones, in the maritime zones of other states, or on the high seas. Difficulties in law enforcement of Flag States make Port State Jurisdiction only option. (Molenaar, 2007,1)

It is commonly recognised that when a vessel willingly arrives a harbour it come to be completely matter of rules and code of practice agreed by the authority of that area for actions concerning to usage and every kinds of ships, navy and additional, are in mutual appreciation in obeying the shoreline code of practice about suitable measures to be engaged and allowable actions inside territorial area. (Hare, 1996, 3)

The United Nations Convention on the Law of the Sea, 1958 (UNCLOS 1958) article 25[2] may be seen as the first worldwide legitimate base for port state control. Article empowered states to consider essential measures to avoid any gap of

[2] *The provisions of this Convention shall not affect conventions or other international agreements already in force…*

circumstances to that the coming of any ships to his harbours can be matter. (Hare, 1996,6)

Articles 216[3] and 218 (UNCLOS 1982) enable a coastal government to apply global anti-pollution and anti-dumping actions, with article 219[4] giving states power to take administrative measures to prevent errant vessels from leaving port. To the extent that an unseaworthy ship may, at least through her bunkers, present an oil pollution threat, authority may be found in these articles for the intervention of a port state authority in most instances. The only limitation was that steps taken be reasonable, public, and not discriminatory. (Hare, 1996,6)

The legal basis for PSC worldwide lies at (UNCLOS), (UN, 1982) article 218: Enforcement by Port states: (Hjorth, 2015,43)

> *"When a vessel is voluntarily within a port or at an off-shore terminal of a State, that State may undertake investigations and, where the evidence so warrants, institute proceedings in respect of any discharge from that vessel outside the internal waters, territorial sea or exclusive economic zone of that State in violation of applicable international rules and standards established through the competent international organization or general diplomatic conference. (UN, 1982)"*

---

[3] *UNCLOS 1982 Article 216: Enforcement with respect to pollution by dumping*

1. Laws and regulations adopted in accordance with this Convention and applicable international rules and standards established through competent international organizations or diplomatic conference for the prevention, reduction and control of pollution of the marine environment by dumping shall be ***enforced:***

(a) ***by the coastal State*** *with regard to dumping within its territorial sea or its exclusive economic zone or onto its continental shelf;*

(b) by the flag State with regard to vessels flying its flag or vessels or aircraft of its registry;

(c) by any State with regard to acts of loading of wastes or other matter occurring within its territory or at its off-shore terminals.

[4] *UNCLOS 1982 Article 219: Measures relating to seaworthiness of vessels to avoid pollution*

Subject to section 7, States which, upon request or on their own initiative, have ascertained that a vessel within one of their ports or at one of their off-shore terminals is in violation of applicable international rules and standards relating to seaworthiness of vessels and thereby threatens damage to the marine environment shall, as far as practicable, ***take administrative measures to prevent the vessel from sailing.*** *Such States may permit the vessel to proceed only to the nearest appropriate repair yard and, upon removal of the causes of the violation, shall permit the vessel to continue immediately.*

1.4. UNITED NATIONS CONVENTION ON THE LAW OF THE SEA (1982)

The seas had for centuries been question to the liberty of-the-oceans principle - a doctrine placed since the 17th century basically restricting domestic privileges and authority over the waters to a thin line of ocean neighbourhood of a state's shoreline. The rest of the oceans was asserted to be open to every nation and property of no one. (www.un.org/unclos)

By 1945, President Harry S. Truman, replying in fragment to force from national petrol benefits, individually stretched US dominion to all seabed belongings to America's continental shelf. That has been the initial main trial to the liberty-of-the-oceans principle. Additional countries shortly did the same. By October 1946, Argentina demanded his continental shelf and seabed and beyond. Peru and Chile in 1947, and Ecuador in 1950, declared autonomous privileges at 200-mile region, eager thus to restrict the entree of foreign fishing flotillas and to reduce the diminution of fish in their neighbouring waters. Short later the World War II, Venezuela, Libya, Saudi Arabia, Ethiopia, Egypt and other East Europe states declare 12-mile territorial water, therefore obviously desertion from the out-dated 3-mile border. (www.un.org/unclos)

The Convention was assembled in New York in 1973. It lasted after 9 years by acceptance by 1982 - the United Nations Convention on the Law of the Sea (UNCLOS 1982) a constitution for the oceans. Throughout that 9 years, travelling forth and back among Geneva and New York, legislative bodies from over 160 independent Countries argued the topics, negotiated and dealt countrywide privileges and requirements in the path of the longwinded discussions which formed the UNCLOS. (www.un.org/unclos)

UNCLOS 1982 had set the standards for sailing privileges, territorial water bounds, commercial authority, legitimate prominence of assets on the ocean bed outside the bounds of domestic authority, track of vessels over narrow passages, preservation and administration of living sea assets, safeguarding of the oceanic surroundings, nautical study management and other features such as process for clearance of disagreements between States. Convention is signed by almost all of the maritime nations. Figure 1.1 provides signing and ratification status of states globally.

Figure 1.1 UNCLOS 1982, Global Signing and Ratification Status (CCS Institute, 2016)

1.4.1. Flag State Inspection/Control (FSI/FSC)

FSC is a result of central law that, excluding in assured unusual circumstances, a commercial vessel on the oceans is matter only to the authority of the state which it flies its flag. Flag state authority is officially accepted in Article 1 of the Brussels 1952 Convention for the Unification of Certain Rules Relating to Penal Jurisdiction in Matters of Collisions or Other Incidents of Navigation. The matter of Art. 1 is repeated in Art. 11 of the Geneva 1958 Convention on the High Seas additionally in Art. 97(1) of the UNCLOS 1982. (Ademuni and Odeke, 1997,3)

According to Dr. Özçayır; the obligation on Contracting States of international conventions is not only to incorporate convention provisions into their legislative system but also to meet their responsibilities, flag States must have the means and the will to implement the requirements of international conventions. (Özçayır, 2000,5)

Owing to the restricted circumstances in which further countries may inhibit, universal rules enforces the flag state the responsibility of guarantee nautical security and the safeguarding of the oceanic surroundings. (Ademuni and Odeke,1997,4) Art. 94(1) of 1982 UNCLOS states that responsibility by pointing;

"... every State shall effectively exercise its jurisdiction and control in administrative, technical and social matters over ships flying its flag."

1.4.2. Port State Control (PSC)

The main legitimate bases verifying for Port State Control are originated in universal accustomed and agreement law. Universal accustomed law concerning PSC is established on the essential doctrine of regional independence. (Kulchtiskyy,2010,11) The harbour is a fragment of country's inner seawaters, that has the similar legitimate position as a portion of terrestrial. As it is mentioned before ships in ports are subject to port state's jurisdiction. So ship has to comply resident regulation in addition to the regulation of her flag. Certainly a state has sovereignty rights on its territorial waters, contiguous waters, over its continental shelf and exclusive economic zone. International law sets the limits and scope of the rights of a state sovereignty over these areas. UNCLOS 1982, signify the definitions, port state's rights over this areas and rights of the foreign ships.

By means of Article 218,219 and 226 of the UNCLOS 1982, PSC is a law enforcement tool for implementing international law. Main purpose on this law enforcement is to eliminate perils of substandard ships to the seafarers and marine environment. It is acknowledged that Port State Control is an action to combine the previous nautical security filter subsequently the previous filter, built by classification societies and flag states, not able to be implemented efficiently. Dr. Özçayır also points that if only in a perfect system where the FSC and classification societies eliminate all of the sub-standard ships there would be no need to PSC. (Özçayır, 2000,9)

Article 227 of UNCLOS 1982 sets the limits for Port State's enforcement rights by *"...in enforcing port State Jurisdiction States shall not discriminate in form or in fact against vessels of any other State"*.

1.5. INTERNATIONAL ORGANIZATIONS CONCERNING PSC

1.5.1. International Maritime Organization (IMO)

It has permanently been acknowledged that the best way of increasing security of ocean is by rising worldwide conventions that are obeyed by all maritime states. In 1948 an international conference in Geneva which was hosted by United Nations (UN) accepted a resolution officially founding IMO (the initial tag was the Inter-Governmental Maritime Consultative Organization (IMCO), then the tag was transformed to IMO in 1982).(www.imo.org/About/HistoryOfImo)

The IMO Convention took effect by 1958. The commitments of the Organization were briefed by Art. 1(a) of Convention;

"... to provide machinery for cooperation among Governments in the field of governmental regulation and practices relating to technical matters of all kinds affecting shipping engaged in international trade; to encourage and facilitate the general adoption of the highest practicable standards in matters concerning maritime safety, efficiency of navigation and prevention and control of marine pollution from ships."

First work of IMO was to approve a re-creation of the International Convention for the Safety of Life at Sea (SOLAS) by 1960, that was the vital of all agreements concerning marine security. (www.imo.org)

During 1960's the development in the quantity of petrol being conveyed over ocean emerged a new threat of "pollution". *"Torrey Canyon"* disaster in 1967 was the last drop to the full glass. Torrey Canyon was oil tanker which initially built with a capacity of 60.000 DWT and later with an upgrade the capacity of the ship was increased 120.000 DWT. (Nanda, 1967) After this disaster, IMO presented a chain of actions intended to stop tanker collisions and to reduce its consequences. IMO moreover tackled the ecological threat resulted by routine operations for example the washing of petrol freight containers and the disposal of machinery compartment trashes. The most significant of all those actions was the International Convention for the Prevention of Pollution from Ships, 1973, as revised by the Protocol of 1978(MARPOL 73/78) linking subject.

During 1970s a worldwide search and rescue structure had been begun, with the founding of the International Mobile Satellite Organization (IMSO), that had significantly upgraded the legacy of broadcasts and additional communications to vessels. Later by 1988, The Global Maritime Distress and Safety System (GMDSS) had been approved. By 1999February, the GMDSS had come to be entirely effective, so as to then a vessel which broadcast distress signal wherever in the globe may be fundamentally assured help. (www.imo.org)

The disaster of "Herald of Free Enterprise" (Ro-Ro Passenger Ferry) in 1987, on which 198 people had lost their lives, pulled the attention to the human factor in maritime safety. (Goulielmos, 2005,14) Two initiative had took place concerning human element in maritime safety during 1990's; these were The International Safety Management (ISM) Code came into force by 1998 and 1995 adjustments to the International Convention on Standards of Training, Certification and Watch-keeping for Seafarers (STCW 1978), came into force by 1997.

To protect marine environment three conventions were adopted by IMO during 2000's. These are Ballast Water Management to prevent the invasion of alien species (BWM 2004), Hong Kong International Convention for the Safe and Environmentally Sound Recycling of Ships 2009 and Anti-Fouling Systems (AFS 2001) on ship recycling. (www.imo.org)

The increase in pirating activities and terrorism triggered new conventions concerning security on-board. By July 2004 of International Ship and Port Facility Security (ISPS) Code has come into force. Additionally, IMO accepted adjustments to the Convention for the Suppression of Unlawful Acts (SUA) Against the Safety of Maritime Navigation in 2005. (www.imo.org)

Without doubt, IMO instruments take the vital role in increasing marine safety on-board and Port State Control efforts play indispensable role in enforcement of these instruments. IMO's recent Member State Audit Scheme, that come to be compulsory by many of important IMO tools on 1 January 2016, is expected to take important role in assisting efficient operation by supplying an inspected Member State with a widespread and neutral valuation of how successfully it manages and outfits that compulsory IMO tools which are enclosed by the Structure.

1.5.2. International Labour Organization (ILO)

The ILO was founded by 1919, as measure of the Agreement of Versailles that finished First World War, to reveal the trust that worldwide and permanent peace may be built only if it is founded on public fairness. ILO's constitution was conscripted during 1919 January to April, by the Labour Commission group of the Peace Conference, that initially encountered in Paris and after in Versailles. The motivating powers for ILO's establishment rose from humanitarian, security, political and monetary respects. (www.ilo.org/history)

ILO has adopted a several regulations which covers seafarers' working conditions. First convention which focus on condition of seafarers in wide coverage might be "Merchant Shipping (Minimum Standards) Convention,1976 (ILO 147)". Prior to ILO 147; major conventions relating maritime labour can be listed as;

- *"Minimum Age Convention, 1973 (No. 138), or*
- *Minimum Age (Sea) Convention (Revised), 1936 (No. 58), or*
- *Minimum Age (Sea) Convention, 1920 (No. 7);*
- *Shipowners' Liability (Sick and Injured Seamen) Convention, 1936 (No. 55),*
- *Sickness Insurance (Sea) Convention, 1936 (No. 56), or*
- *Medical Care and Sickness Benefits Convention, 1969 (No. 130);*
- *Medical Examination (Seafarers) Convention, 1946 (No. 73);*
- *Prevention of Accidents (Seafarers) Convention, 1970 (No. 134)(Articles 4 and 7);*
- *Accommodation of Crews Convention (Revised), 1949 (No. 92);*
- *Food and Catering (Ships' Crews) Convention, 1946 (No. 68) (Article 5);*
- *Officers' Competency Certificates Convention, 1936 (No. 53) (Articles 3 and 4) ;*
- *Seamen's Articles of Agreement Convention, 1926 (No. 22);*
- *Repatriation of Seamen Convention, 1926 (No. 23);*
- *Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87);*
- *Right to Organise and Collective Bargaining Convention, 1949 (No. 98)."*

Text of the MLC 2006 explains the purpose and the coverage of the convention as:

"Desiring to create a single, coherent instrument embodying as far as possible all up-to-date standards of existing international maritime labour Conventions and Recommendations, as well as the fundamental principles to be found in other international labour Conventions, in particular:"

- *"the Forced Labour Convention, 1930 (No. 29);*
- *the Freedom of Association and Protection of the Right to Organise Convention, 1948 (No. 87);*
- *the Right to Organise and Collective Bargaining Convention, 1949(No. 98);*
- *the Equal Remuneration Convention, 1951 (No. 100);*
- *the Abolition of Forced Labour Convention, 1957 (No. 105);*
- *the Discrimination (Employment and Occupation) Convention, 1958 (No. 111);*
- *the Minimum Age Convention, 1973 (No. 138);*
- *the Worst Forms of Child Labour Convention, 1999 (No. 182)"*

MLC 2006 regulates the coming in to force by article 8 as: "Convention shall come into force 12 months after the date on which there have been registered ratifications by at least 30 Members with a total share in the world gross tonnage of ships of at least 33 per cent." Agreement has become operational in August 20th, 2013 by the requirements of article 8 has been reached. By March 2017 the convention has been ratified by 81 member states with coverage of 91 per cent in the world total gross tonnage. (www.ilo.org/mlc)

1.5.3. European Maritime Safety Association (EMSA)

The European Maritime Safety Agency is a dispersed organisation of EU. IT is grounded in Lisbon, the Organisation delivers procedural aid and backing to the Member States and European Commission in the progress and application of EU regulation on marine security, contamination from vessels and marine safety. Moreover, it has functional jobs in the area of petrol contamination reaction, ship watching and in distant tracking and identification of vessels.

A main managerial motivation to the creation of EMSA by 2003 was the Prestige (2002) and the Erika (1999) disasters and caused petrol leaks. Those events caused in enormous ecological and fiscal destruction to the shorelines of France and

Spain. Furthermore, they performed as a prompt to decision-makers which Europe required to spend in superior preparation for an extensive petrol leak. (www.emsa.europa.eu)

One of the objectives of EMSA concerning PSC is stated as:

"EMSA has been given the technical responsibility for monitoring of port State control at EU level. This involves assessing the functioning of the port State inspection systems set up by individual EU members, undertaking a comprehensive analysis of global statistics relating to vessels calling at EU ports, as well as analysis of data on individual ship inspections. Risk assessment studies combined with statistical research provide results which are used to develop objectives and procedures for the continuous improvement of EU port State control performance."

1.5.4. Maritime Classification Societies

Classification societies are non-governmental organizations (mostly commercial institutions) which give assurance services in technical standards of ships and offshore platforms. A classification society performs inspections during the construction and operation of ships and offshore structures. The society will also validate that construction is according to these standards and carry out regular surveys in service to ensure compliance with the standards. At the end of surveys classification society issues a certificate which validate the fitness for purpose, seaworthiness and safety of the vessel.

As the volume of business increased so did the framework of regulations imposed by the insurance industry. In the eighteenth century the London insurance industry developed a system to check that the ships they insured were soundly built and in good condition. By the early nineteenth century Lloyd's Register, which had started life in the 1760s as a register of ships, had assumed the role of setting standards and issuing classification certificates. (Stopford, 2009,35)

Later holding a certificate to assure safety of ship had become a mandatory condition by SOLAS 1914; article 57 obligates certification as;

"A certificate, called a "Safety Certificate", shall be issued, after inspection and survey, to every ship which complies in an efficient manner with the requirements of the Convention. ..."

"In every case the Government concerned fully guarantees the completeness and efficiency of the inspection and survey. ..."

"The Safety Certificate shall be issued by either officers of the State to which the ship belongs, or by any other person duly authorised by that State. In either case the State to which the ship belongs assumes full responsibility for the certificate."

As SOLAS 1914 gives all responsibilities to Flag States, maritime states authorise Classification Societies to do inspection and surveys on behalf of those states. By 1960's open registries have become a thread for maritime safety because of their inability or unwilling to perform efficient inspections over the ships those fly their flag. Port state authorities as well as MoU organisations has started to publish a list of certification societies namely "Recognised Organisations" to clarify whose certification is valid within their territory.

It can be said that; Port States are highly dependent for these "Recognised Organisations" because it is practically very hard to decide for criteria for safety and inspect all the ships with that manner. Instead of it, PSCOs check the presence of valid certification and conditions of the ship according to certificates.

1.6. MAIN INTERNATIONAL CONVENTIONS CONCERNING PSC

1.6.1. International Convention on Load Lines (LL 1966)

The International Convention on Load Lines came into effect in 1930 and later adopted in 1966 in London and was operationalized in 1968. The total parties to the convention were 161 with 40 signatories.

Its provisions were made to determine the freeboard of vessels by divinising and calculations of damaged stability. Regulations of this particular convention took in to consideration of the possible perils that were existent in various areas during various periods. Its procedural extension comprised of numerous extra security actions regarding, hatchways, doors, and freeing ports. Their main objective was ensuring waterproof integrity of vessels' bodies underneath the waterline.

1.6.2. International Convention for the Safety of Life at Sea (SOLAS 1974)

This convention was signed by 1974 November 1st in a conference convened by IMO and later operationalized on 25th May 1980. It has undergone two main amendments in the years 1978 and 1988.

All parties to the agreement were tasked to undertake and give effect to the requirements of the agreement, which constituted an integral part of the present Convention. Further, contracting parties were to broadcast laws, rulings, instructions and guidelines including taking additional relevant phases to make the convention complete and wide-ranging effect, and guarantee that, from the opinion of security of life, a vessel is appropriate enough.

1.6.3. International Regulations for Preventing Collisions at Sea (COLREG 1972)

This refers to regulations published by the International Maritime Organization stipulating the "rules of the road" or rather navigation rules to be observed by vessels and other ships at waters to contain crashes among two or more ships. This convention was signed in London in 1972 by the member states. Currently the convention has 150 contracting parties who represent around 98% of the gross tonnage of the global commercial fleet.

Among the significant innovations of the COLREG was the acknowledgement agreed to schemes of maritime traffic separation. This gave supervision in defining safe speed, collision risk and the behaviour of ships sailing in close to schemes of maritime traffic separation.

1.6.4. International Convention for the Prevention of Pollution from Ships (MARPOL 1973/1978)

The MARPOL had been accepted by 1973 November 2nd at International Maritime Organization and thus its guidelines enclosed contamination by petrol, harmful substances in packaged form, chemicals, garbage and sewage. The 1978 protocol that related to the earlier 1973 MARPOL had been accepted at a Conference on Tanker Safety and Pollution Prevention in 1978 February as a reaction to an

increase of tanker collisions between 1976 and 1977. The agreement has procedures intended to avoiding and reducing contamination from vessels, both unintended contamination and that from predictable processes.

1.6.5. International Convention on Tonnage Measurement of Ships (1969)

This was enacted at London during the International Maritime Organization in 1969 and came in to force in 1982. The concept of tonnage was introduced to define a measurement of a ship size to be used as a basis for taxes, port and harbour fees. The idea of ship for general cargo was developed to take advantage of the tonnage definition prior to the Convention of 1969. These ships had a light deck above the main deck, continuous from stern to stem and provided with at least one opening (Open Shelter Deck) or without openings (Closed Shelter Deck). The main aim was to increase the cargo capacity without raising the tonnage. This convention treaty was to guarantee that vessels were assumed rational fiscal protection, as harbour and additional fees were accused by means of vessel tonnage.

1.6.6. International Convention on Standards of Training, Certification and Watch-keeping for Seafarers (STCW) (1978)

This convention was adopted in 1978 in London and was operationalized in 1984 with an aim of promoting protection of life and assets at sea and the safety of the maritime ecology by founding in mutual treaty worldwide criterions of exercise, documentation and watch keeping for seafarers. It targeted 25 ratifications from collective commercial fleets of which set up more than 50% of the tonnage of the global commercial shipping of vessels which are more than 100 tonnes. The contracting parties to the convention comprised of 161 IMO parties.

1.6.7. Merchant Shipping (Minimum Standards) Convention (ILO 147, 1976)

This convention was signed in 1976 in Geneva and later operationalized in 1981. Member parties were to have in place laws stipulating for all vessels registered in their region met the following security criterions, suitable social security actions, on-board circumstances of working and on-board accommodation/catering standards.

1.6.8. Maritime Labour Convention (MLC, 2006)

The Maritime Labour Convention is an International Labour Organization convention that was in Geneva, in 2006 as the 4th stage of the worldwide maritime law which comprises last updated principles of present worldwide seafaring labour agreements and endorsements. It was agreed by members of the International Maritime Organization.

Convention has come into force in August 20th, 2013 by the requirements of article 8 has been reached. By March 2017 the convention has been ratified by 81 member states with coverage of 91 per cent in the world total gross tonnage.

1.7. LITERATURE REVIEW AND RECENT RESEARCHS CONCERNING PSC

The Port State Control (PSC) came in to being because of the 1982 Memorandum of Understanding that was signed by the most advanced maritime nations in the Western Europe. The PSC's mandate is inspecting ships coming from different destinations calling to their ports with an intention of ascertaining that set standards of navigational safety are observed.

Port State Control means that nations have authority of control over any vessel present within their port. Ports form part of internal waters of a nation, hence authorizing such a nation to implement its maritime laws in opposition to any ship. Each of the member entities (nations) bear the authority to carry inspection on ships that berth on either of their ports voluntarily in compliance with safety and marine environment. The right to inspection is anchored in the IMO treaties, for example in SOLAS it is stipulated that: "Each ship when in the port of another entity is subject to control by officers duly authorized by such government." (UNCLOS, 1982). IMO treaties for instance MARPOL, Load Line and STCW have the same clause as above. Further, in the ILO MLC, 2006 Treaty a distinct section is attributed to Port State Control, that covers 14 areas to cover during inspection of a ship. The areas covered include: supposed hours of working or rest, the qualifications of seafarers, levels of manning the ship, health, safety and accident prevention as well as on-board complain modalities (MLC, 2006).

As earlier noted, the audacity to carry out inspection of a ship is well stipulated in the different agreements. Therefore, a Member Entity (that includes the port state) is only allowed to enforce (PSC) inspection on foreign-flagged ships on the Treaty (subject) of which the entity is a Party. Port states are under instruction to honour documentation or rather certification given out by a flag state, or by a RO on his behalf, as a prima facie evidence of conformity (SOLAS, Ch.1, art. 19).

Molenaar (2007) views PSC as a significant instrument steered towards combating marine pollution that is steadily shifting from being voluntary to being compulsory at the regional level. It is worth noting that the effect of PSC as a research area has been undertaken by a number of academicians too. For instance, Cariou et al (2007) asserted after carrying an analysis of 874 different and repeated inspections that following a PSC inspection, the recorded deficiencies in the course of the following inspection declined by 63% (Cariou, Mejia and Wolf, 2007). In a different research carried out by (Knapp, 2007) interrogated the impact of inspections by PSC on the likelihood of causality and it emerged that, for any vessel under inspection in one of the PSC regimes, the likelihood of occurrence of a serious causality declines steadily as the frequency of inspections increases (Knapp and Franses, 2008). Further, the study asserted that about 43% of the entire vessels' originality could be traced to belong to a group where inspections were effective in declining the likelihood of causality cases where its effect was strong for each serious causality and estimated- depending on the essential ship risk profile to be a 5% decline per inspection (Ibid)

The targeting as well as the criteria for selection in the famous Paris MoU changed since 1st January 2011, as a result of the New Inspection Regime (European Parliament and of the Council, 2009). The devised new Ship Risk Profile (SRP) included generic aspects (for instance, ship type, age, flag performance and company performance) as well as historic aspects (deficiencies and detentions).

All ships that are either detained or banned (denied access to ports) are displayed on the website of Paris MoU. This as a result generates a 'naming and shaming' effect that contributes to averting future detentions as well as banning since the available to the public for viewing thus can be taken into account by charterers. The objective of realizing the Paris MoU by averting sub-standard shipping may seem ambitious and Payoyo (2009) asserted that PSC inspections showed that the total

number of sub- standard ships had increased, even though the Paris MoU has recorded much success. The successes include, success in identifying sub-standard ships, success in enforcing international agreements, cooperation in the region hence efficient resource use as well as enhanced cooperation among MoU member states including expansion of the MoU region (Payoyo, 1994). Besides, the average detention percentage has declined since 2008 to an all-time low in 2014 (Paris MoU, 2015 Annual Report)

Former researches mainly focus on the effectiveness of the PSC inspection such as Molenaar and Payoyo. Cariou et al's concern was the enhance performance of the "targeting and prioritization criteria". Knapp tried the present the effects of PSC to global maritime casualties, while doing these Knapp and Cariou both proposed models for probability of a detention for certain ship types. However, it is hard to find a research which directly focus on "economic effects of detention to suspected ships". This research may be the first study for filling this research gap.

CHAPTER 2

REGIONAL CONTROL REGIMES AND INSPECTION POLICY OF PARIS MoU

2.1. REGIONAL CONTROL REGIMES AND MEMORANDUMS OF UNDERSTANDING (MoU's)

All regional port state control MoUs encourage national port authorities to inspect vessels which call their ports to eliminate those vessels have not been constructed, are furnished, manned and worked with abeyance to the principles set by the applicable worldwide and national instruments. If vessels are detected as not being in compliance with the standard-setting instruments, the port state may prevent the vessel from leaving until the defects have been rectified. It is hoped that as further nations and regions accept port state control, implementation of worldwide sea going ship criterions will be improved and ship-owners will carry out to fulfil with the criterions willingly rather than threat of facing potential delays or penalties. (McDorman, 2000:3)

2.1.1. Paris MoU

The Paris MoU on PSC is a managerial contract among 27 Maritime Authorities. It had been contracted in 1982 January by 14 European nations at a Ministerial Conference alleged in France, Paris. It come into force by 1982 July 1st. The body extended to 27 participant Countries after years.

The present participant Countries of the Paris MoU are: Spain, Croatia, Canada, Denmark, Bulgaria, Estonia, Germany, France, Finland, Iceland, Greece, Italy, Ireland, Malta, Lithuania, Slovenia, Norway, the Netherlands, Romania, Portugal, Poland, Cyprus the Russian Federation, Latvia, Belgium, the United Kingdom and Sweden.

There is a secretariat body of organisation located in Hague, Netherland. The Secretariat Paris MoU on PSC is responsible for the effective implementation of the Paris Memorandum of Understanding. In terms of content the Secretariat is managed by the member States and the MoU Advisory Board (the executive board). The

Secretariat has its own budget that annually is adopted by the Port State Control Committee. (www.parismou.org)

According to last published Annual Report (2015) of Paris MoU, some key statistics are presented on Figure 2.1.

PARIS MoU INSPECTION SUMMARY														
INSPECTIONS			DETENTIONS						NUMBER OF BANNED VESSELS			FLAG STATES CLASSIFIED AS		
2013	2014	2015	2013	%	2014	%	2015	%	2013	2014	2015	WHITE	GREY	BLACK
17.687	18.430	17.858	668	3,78	612	3,32	595	3,33	29	20	11	43	19	11

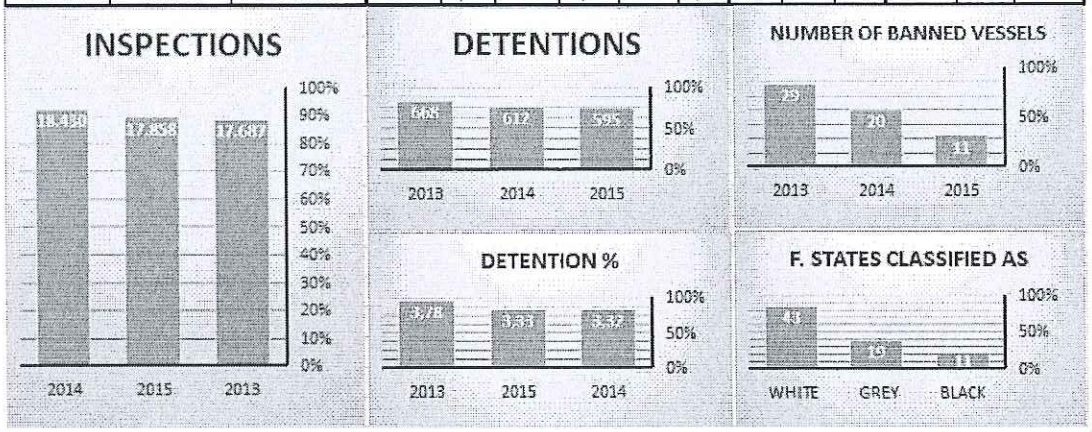

Figure 2.1 Inspection Summary of Paris MoU (Data Source: 2015 An. Report of Paris MoU)

2.1.2. Tokyo (Asia-Pacific) MoU

The Memorandum had been shaped in Tokyo by 1993 December and become effective by 1994 April 1st. In harmony with the necessities of the Memorandum, Authorities that had contracted and officially recognised the Document or those ones which had been acknowledged by common consensus of the Port State Control Committee became complete participants. Presently, the Memorandum has twenty complete participants, namely: Canada, Australia, China, Chile, Fiji, Indonesia, Hong Kong (China), Republic of Korea, Japan, the Republic of the Marshall Islands, Malaysia, Papua New Guinea, New Zealand, the Philippines, Peru, Singapore, the Russian Federation, Vanuatu, Thailand and Viet Nam.

The leading purposes of the Memorandum are to create an operative PSC regime within the Asia-Pacific area by collaboration of its participants, coordination of the members' actions, to reduce deficient vessels, to improve seafaring safety, to safeguard the nautical ecology and to protect maritime labour and working environments on-board vessels. (Tokyo MoU Annual Report 2015)

In harmony with the necessities of the Memorandum, Tokyo MOU Secretariat was established on 15 March 1994 in Tokyo, Japan. Mai duties of the Secretariat are to serve Port State Control Committee and other meetings, to organize PSC officers training courses and seminars, to conduct research and analysis of the PSC inspection data in the region, to collect and disseminate information regarding PSC for the participating Authorities, to assist in providing technical assistance. (tokyo-mou.org)

According to last published Annual Report (2015) of Asia-Pacific MoU, some key statistics are presented on Figure 2.2.

ASIA-PACIFIC (TOKYO) MoU INSPECTION SUMMARY											
INSPECTIONS			DETENTIONS						FLAG STATES CLASSIFIED AS		
2013	2014	2015	2013	%	2014	%	2015	%	WHITE	GREY	BLACK
31.018	30.405	31.407	1395	4,50	1203	3,96	1153	3,67	36	17	12

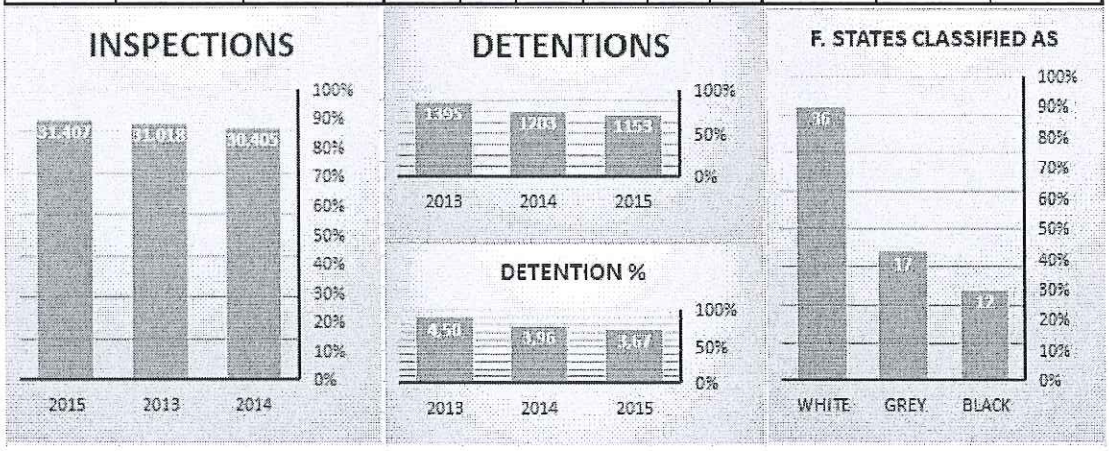

Figure 2.2 Inspection Summary of Asia-Pacific MoU (Data Source: 2015 An. Report of Asia-Pacific MoU)

2.1.3. Latin America MoU (Acuerdo de Vina del Mar)

The Latin American Agreement on Port State Control of Vessels had been accepted by 5th Resolution of the Meeting No:6 of the Operative Network for Regional Cooperation Among Maritime Authorities of South America, Cuba, Mexico and Panama (ROCRAM), held on 5 November 1992.

The Convention was initially pledged by Brazil, Argentina, Chile, Colombia, Mexico, Ecuador, Peru, Panama, Venezuela and Uruguay thus, a major international step was taken since this was the first developing region to reach this sort of operational agreement. At present, the Latin American Agreement of Viña del Mar is formed by the following full Members: Brazil, Argentina, Colombia, Chile, Ecuador, Cuba, Honduras, Guatemala, Panama, Mexico, Dominican Republic, Peru, Venezuela and Uruguay. (www.alvm.prefecturanaval.gob.ar) Secretariat of Latin America MoU is located in Buenos Aires, Argentina.

According to published last three Annual Reports (2013,2014,2015) of Latin America MoU, some key statistics are presented on Figure 2.3.

LATIN AMERICA (VINA DEL MAR) MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2013	2014	2015	2013	%	2014	%	2015	%
9.088	9.366	8.860	73	0,80	76	0,81	60	0,68

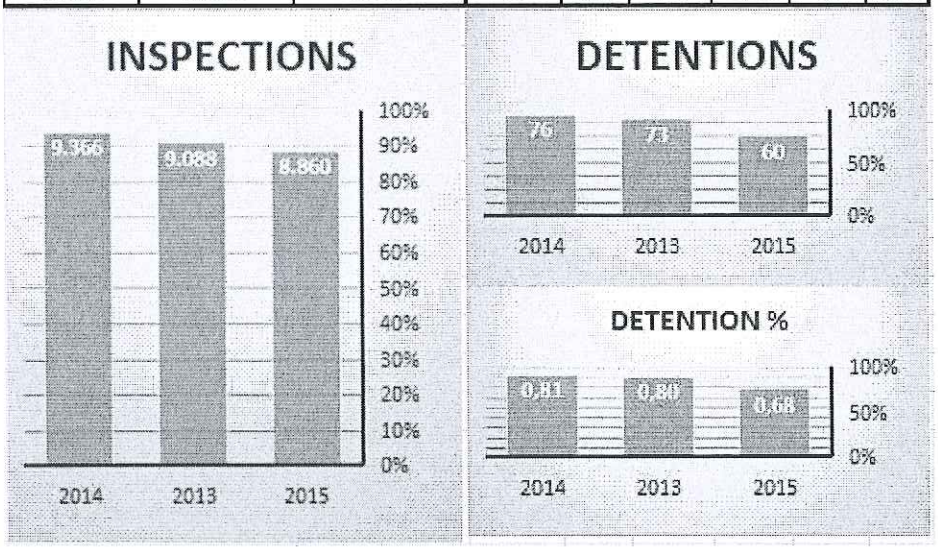

Figure 2.3 Inspection Summary of Latin America MoU (Data Source: 2013,2014,2015 An. Reports of Latin America MoU)

2.1.4. Caribbean MoU (CMOU)

The Memorandum of Understanding on PSC within the Caribbean Area was contracted in Christ Church, Barbados on 9 February 1996 by nine States namely: Barbados, Antigua & Barbuda, Grenada, Dominica, Jamaica, Guyana, Suriname, the Netherlands Antilles and Trinidad and Tobago.

Initially, the Secretariat was located at Barbados at the office of the Maritime Administration. The Secretariat was subsequently relocated to Jamaica in 2002 at the Maritime Authority of Jamaica. The main objective of the Secretariat is to conduct the day-to-day administrative activities of the CMOU. It provides a liaison point and so facilitates the exchange of information among the Members, Observers, the IMO and other PSC regimes and affiliated organizations. It is responsible for the organization of all meetings and workshops/seminars of the CMOU and the Secretary is mandated to represent the CMOU at various meetings throughout the year. (www.caribbeanmou.org)

According to last published Annual Report (2015) of Asia-Pacific MoU, some key statistics are presented on Figure 2.4.

CARAIBBEAN MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2013	2014	2015	2013	%	2014	%	2015	%
994	836	867	18	1,81	15	1,79	18	2,08

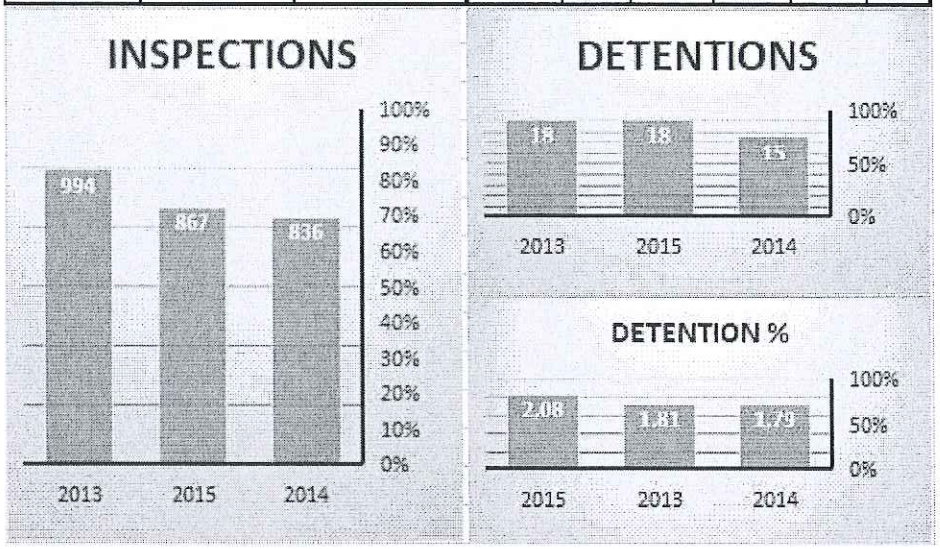

Figure 2.4 Inspection Summary of Caribbean MoU (Data Source: 2015 An. Report of Caribbean MoU)

2.1.5. Abuja MoU

The Abuja MoU on PSC had been contracted at a Ministerial Conference alleged in Abuja, Nigeria by 16 Central and West African Countries on 22 October 1999. The assembly was structured by the IMO and hosted by the administration of the Nigerian Federal Republic.

Member States of the Abuja-MoU region are Benin, Angola, Cape Verde, Cameroon, Cote d'Ivoire, Congo, Ghana, Gabon, Equatorial Guinea, Guinea, Mauritania, Liberia, Nigeria, Namibia, Sierra Leone, Senegal, Sao Tome and Principe, South Africa, Guinea Bissau, Democratic Republic of Congo, Togo and The Gambia.

The Abuja MoU Secretariat headed by a Secretary General is hosted by Government of Nigeria at Lagos. The Secretariat's work includes harmonization of PSC inspection practices and procedures, collation of inspection reports, organization of

Committee meetings, exchange of information, facilitation of training and workshops, and preparation of annual reports. (www.abujamou.org)

ABUJA MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2013	2014	2015	2013	%	2014	%	2015	%
3.211	2.916	2.348	12	0,37	14	0,48	9	0,38

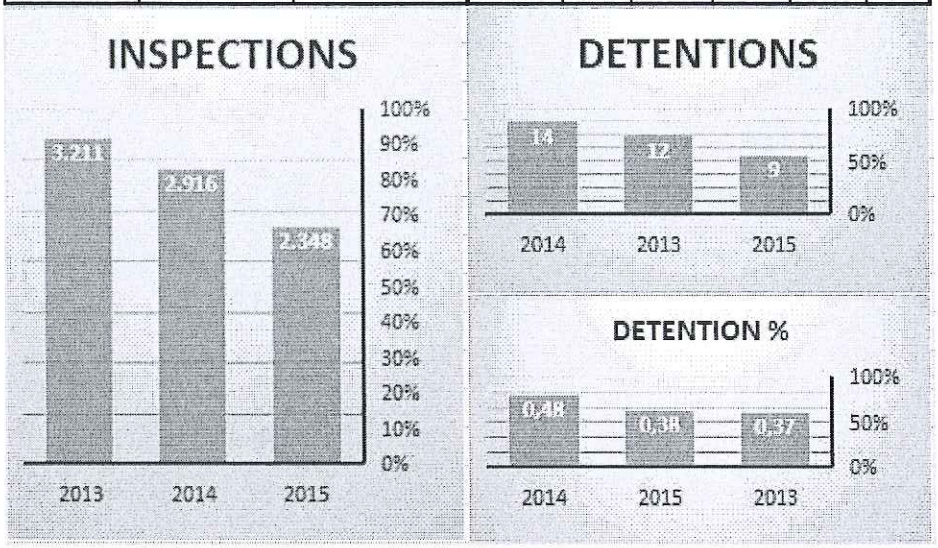

Figure 2.5 Inspection Summary of Abuja MoU (Data Source: 2013,2014,2015 An. Reports of Abuja MoU)

According to published last three Annual Reports (2013,2014,2015) of Abuja MoU, some key statistics are presented on Figure 2.5.

2.1.6. Black Sea MoU (BSMOU)

The Memorandum was contracted by the maritime Authorities of Georgia, Bulgaria, Russian Federation, Romania, Ukraine, and Turkey on April 1st, 2000 in Istanbul. On December 2000, permanent secretariat of Black-Sea MoU was founded in Istanbul. (www.bsmou.org)

The main ideas of establishment of BSMOU regional PSC regime may be summarized as;

- each member Authority establishes PSC system on national level;
- agreed relevant instruments are used for the control of ships;
- common PSC procedures are applied during PSC inspections;

- actions against substandard ships are harmonized and coordinated;
- mutual comprehensive information exchange is provided.

According to last published Annual Report (2015) of Asia-Pacific MoU, some key statistics are presented on Figure 2.6.

BLACKSEA MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2013	2014	2015	2013	%	2014	%	2015	%
5.080	5.092	4.997	184	3,62	151	2,97	218	4,36

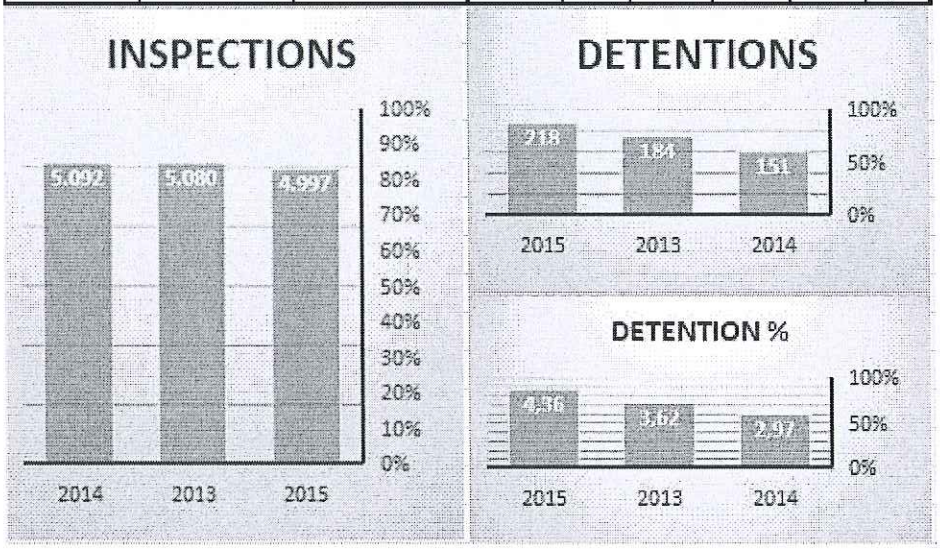

Figure 2.6 Inspection Summary of Black Sea MoU(Data Source: 2015 An. Rep. BSMOU)

2.1.7. Mediterranean MoU (MedMoU)

Mediterranean MoU (MedMoU) agreement was prepared through two meetings the 1st was held in Tunisia 25-29 March 1996 and the 2nd in Casablanca, Morocco from 10-14 December 1996. The Third Final Preparatory Meeting on the founding of a PSC Covenant in the Mediterranean area took place in Valletta, Malta, from 8 to 11 July 1997, At the end of the assembly, the Mediterranean MOU on PSC was contracted by the Legislatures of 8 Nations namely: Cyprus, Algeria, Israel, Egypt, Morocco, Malta, Turkey and Tunisia. Later 1997 the Med. MOU was signed by Lebanon and by Jordan in July 1999. (www.medmou.org)

Secretariat of MedMuU is located in Alexandria, Egypt and also Information system is established and maintained in Casablanca, Morocco.

According to last published Annual Report (2014) Mediterranean MoU, some key statistics are presented on Figure 2.7.

MEDITERRANEAN MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2012	2013	2014	2012	%	2013	%	2014	%
5.680	4.765	5.049	430	7,57	269	5,65	298	5,90

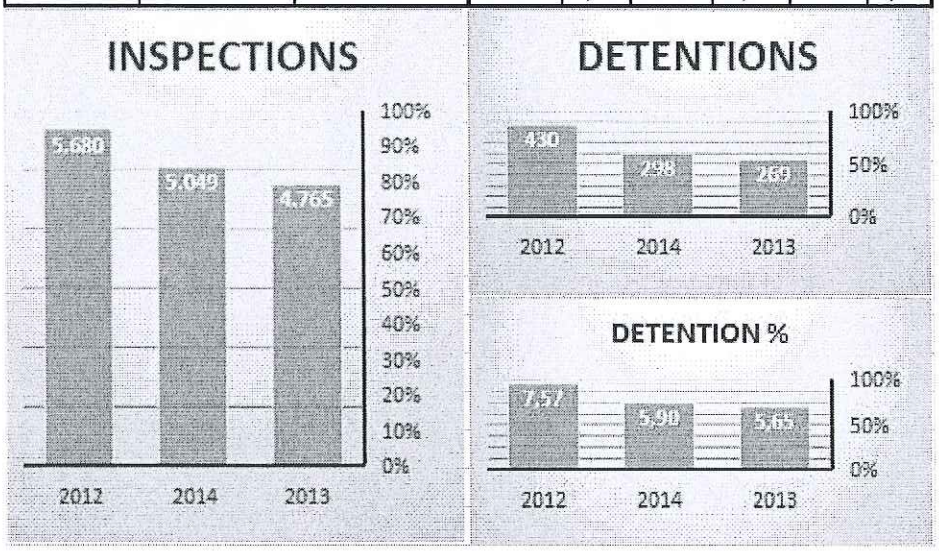

Figure 2.7 Inspection Summary of Mediterranean MoU (Data Source: 2014 An. Report MedMoU)

2.1.8. Indian Ocean MoU (IOMOU)

Initial preliminary assembly on the evolving of flag and port State abilities in the Indian Ocean edge was alleged during 13 - 17 October 1997, at Mumbai, Missions from the subsequent nations joined the assembly: Bangladesh, Australia, Eritrea, Djibouti, India, Ethiopia, Maldives, Kenya, Mozambique, Mauritius, Oman, Myanmar, Singapore, Seychelles, Sri Lanka, South Africa, Yemen and Tanzania.

The initial commission assembly of MOU had taken place at Goa between 20 and 22 January 1999. Throughout that era and at the initial assembly, the subsequent nations contracted approval of the Memorandum of Understanding: Eritrea, Australia,

Sudan, India, Tanzania and South Africa. Afterwards, Srilanka, Mauritius, Kenya, Iran, Oman, Maldives, France, Yemen, Comoros, Bangladesh and Mozambique agreed to the MOU. By 2013 September 17 nations had become participants to the Memorandum. The Memorandum became effective by 1999 April 1st.

The Indian Ocean Memorandum of Understanding Secretariat is grounded in India at Goa. The Secretariat is ruled by and responsible to the Committee of the IOMOU on PSC. It organises the Committee assemblies and supports the Committee in its events. (www.iomou.org)

According to published last three Annual Reports (2014,2015,2016) of IOMOU MoU, some key statistics are presented on Figure 2.8.

INDIAN OCEAN MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2014	2015	2016	2014	%	2015	%	2016	%
6.059	6.253	6.010	379	6,26	350	5,60	370	6,16

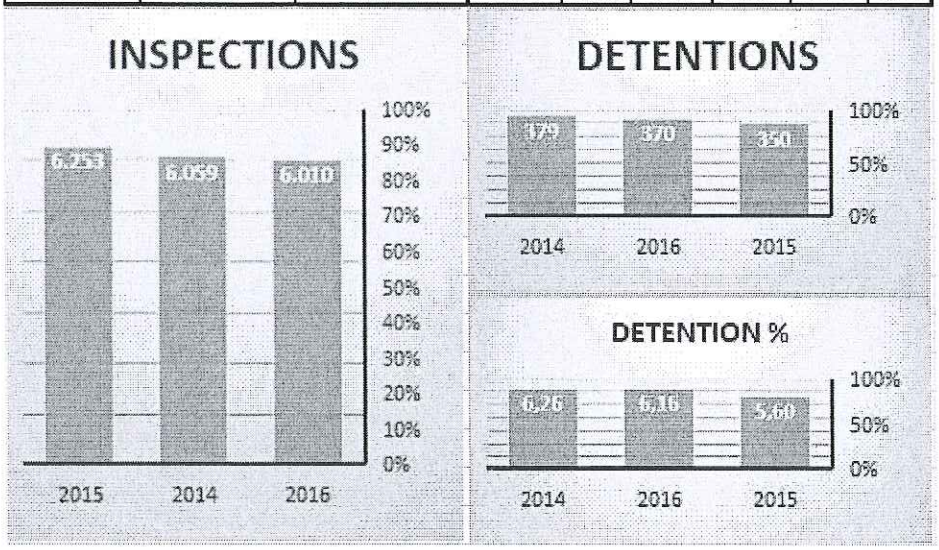

Figure 2.8 Inspection Summary of Indian Ocean MoU (Data Source: 2014,2015,2016 An. Reports of Indian Ocean MoU)

2.1.9. Riyadh MoU

The Riyadh Memorandum of Understanding on PSC in the Gulf Area, acknowledged as the Riyadh MOU, had been contracted at a assembly at Riyadh by

six nations namely Kuwait, Bahrain, Qatar, Oman, UAE and Saudi Arabia, in 2004 June.

The Riyadh MoU obligates the nautical authorities of the 6 Gulf Countries to a combined organisation of PSC actions and to strengthen collaboration and data interchange on subjects regarding to PSC.

The Riyadh MoU called for the founding of a Secretariat and Data Centre in Oman. The Secretariat also host a Data Centre that will log and interchange information on vessels.(www.riyadhmou.org)

According to published last two Annual Reports (2014,2015) of Riyadh MoU, some key statistics are presented on Figure 2.9.

RIYADH MoU INSPECTION SUMMARY								
INSPECTIONS			DETENTIONS					
2013	2014	2015	2013	%	2014	%	2015	%
3.481	3.748	4.165	33	0,95	44	1,17	32	0,77

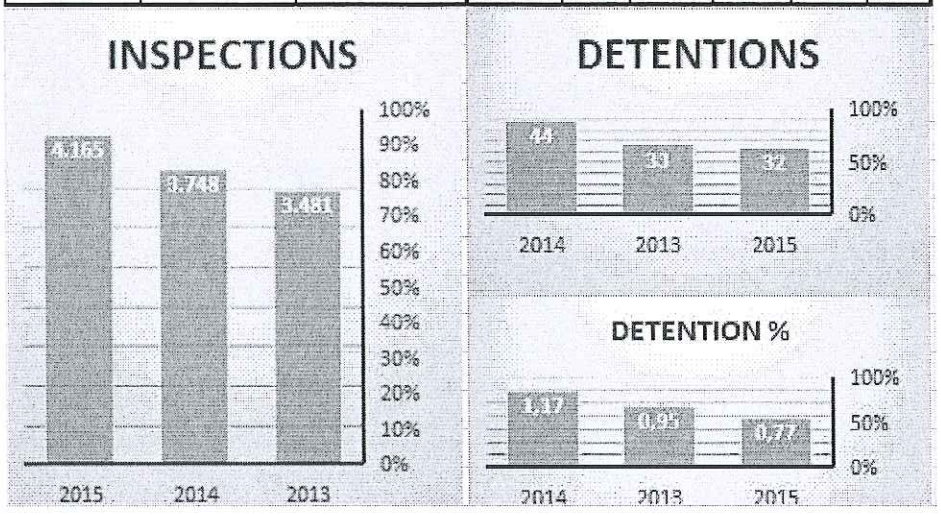

Figure 2.9 Inspection Summary of Riyadh MoU (Data Source: 2014,2015 An. Reports of

Riyadh MoU)

2.1.10. USA and Port State Control Regime of USCG

Port State Control activities are done by US Coast Guard (USCG) within US territory. An office under USCG organization namely "The Office of Commercial Vessel Compliance" (CG-CVC) advances and continues strategy and principles, for the avoidance actions of the Coast Guard to realize Maritime Security, Safety, and Stewardship task accomplishment. The Office of Commercial Vessel Compliance comprises procedure specialists in foreign, domestic, and fishing ships as well as merchant mariner credentialing.(www.uscg.mil/hq/cgcvc)

CG-CVC has 4 divisions which are responsible from domestic ships(CG-CVC-1), foreign ships (CG-CVC-2), fishing vessels (CG-CVC-3) and merchant mariner credentials (CG-CVC-4). Port State Control is a duty of CG-CVC-2 division.

The Coast Guard's Port State Control program confirms that foreign flagged ships working in U.S. seas fulfil with appropriate U.S. laws, U.S. regulations and worldwide conventions. In a struggle to decrease losses and injuries; damage or loss of assets or the maritime ecology; and disturbances to seafaring business, PSC inspections emphasis on ships most prospective to be insufficient, based on acknowledged risk aspects. Whenever ships which are not in considerable submission with appropriate regulations or laws are recognized, the Coast Guard forces inspections till the deficient situations have been fixed and the ships are got into compliance. The objective of the PSC program is to detect and reduce deficient vessels from U.S. seas. (www.uscg.mil/cgcvc/cvc2/psc)

USCG cooperates and exchanges information with other PSC regimes globally. USCG publishes statistical data through annual reports as other MoU secretariats do.

According to published last three Annual Reports (2013,2014,2015) of USCG Port State Control Division, some key statistics are presented on Figure 2.10.

USCG PORT STATE CONTROL ACTIVITIES SUMMARY															
SAFETY EXAMINATIONS			DETENTIONS						SECURITY EXAMINATIONS			SEC. MAJOR CONTROL ACT.		
2013	2014	2015	2013	%	2014	%	2015	%	2013	2014	2015	2013	2014	2015
9.394	9.232	9.265	121	1,29	143	1,55	202	2,18	8584	8562	8655	8	10	11

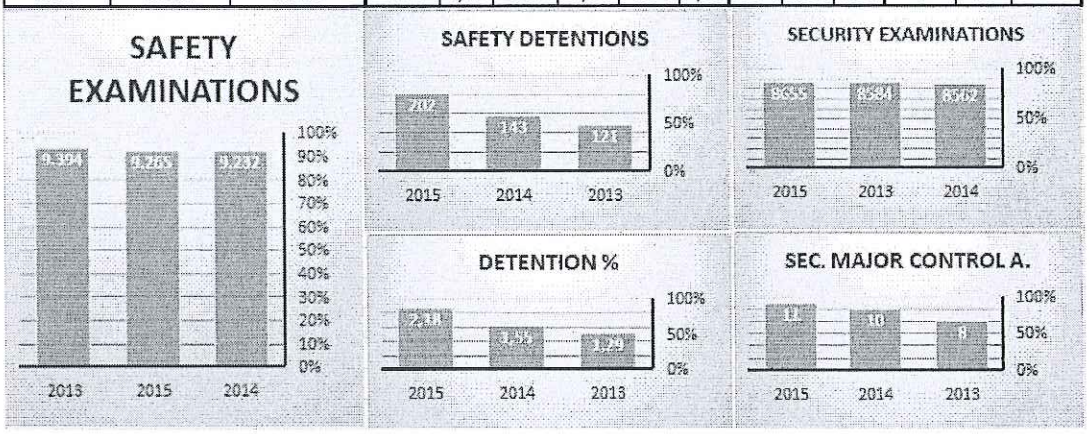

Figure 2.10 Inspection Summary of USCG (Data Source:2013,2014,2015 An. Reports of USCG Port State Control Division)

2.2. INSPECTION POLICY AND IMPLEMENTATION OF PARIS MoU

European Parliament issued directive 2009/16/EC on 23rd of April 2009 that caused modifications to the PSC management within the EU. This was followed by the announcement of the Paris Memorandum of Understanding (MOU) group, after its 43rd Committee meeting in Dublin held during May 2010, that it was to adopt the "New Inspection Regime" or "NIR". The directive proposes wide-ranging changes to the system of port state control inspections with effect from 1st January 2011, the impact of which is addressed in this issue of Risk Alert.

This change was considered necessary in order to move further to a unified Maritime Transport Strategy within the Union. The organisation is now more information centred and consequently the former SIReNaC information system had been substituted with the new structure named THETIS. This provided centrally alleged data source. This database was enhanced by the Sea Safety Net which provides accurate information about ship movements within the European Union. (Steamship Insurance Man.Ltd.,2010:1)

Some of the specific changes; the most striking and obvious change is the move to a requirement for all vessels to go through examination, in dissimilarity to the 25 percent sample method which was formerly used within the Paris MOU and the introduction of a risk profile structure to define the regularity of examination. The profiling of a ship takes a large number of factors into account. The profile is built on generic information such as ship's flag, company and historic parameters like performance of vessel on port state control examinations and leads to a description in one of three sets: low, standard and high risk. The basic intervals between inspections are 6 months, annually and every 3 years respectively. The vessel and the corporation have two distinct risk profiles. If there is a bad performance vessel in a corporation's fleet, then this can have an influence on the other vessels in its fleet by growing the company risk profile. (Ibid)

2.2.1 Organization of Paris MoU

The association contains twenty-seven contributing nautical Governments and covers the seawaters of the Coastal States of Europe and the North Atlantic basin from Europe to North America. The present participant Countries of the Paris MoU are: Bulgaria, Belgium, Croatia, Canada, Denmark, Cyprus, Finland, Estonia, Germany, France, Iceland, Greece, Italy, Ireland, Lithuania, Latvia, the Netherlands, Malta, Poland, Norway, Romania, Portugal, Slovenia, the Russian Federation, Sweden, Spain and the United Kingdom. (www.parismou.org) Figure 2.11 visualizes regional scope of Paris MoU.

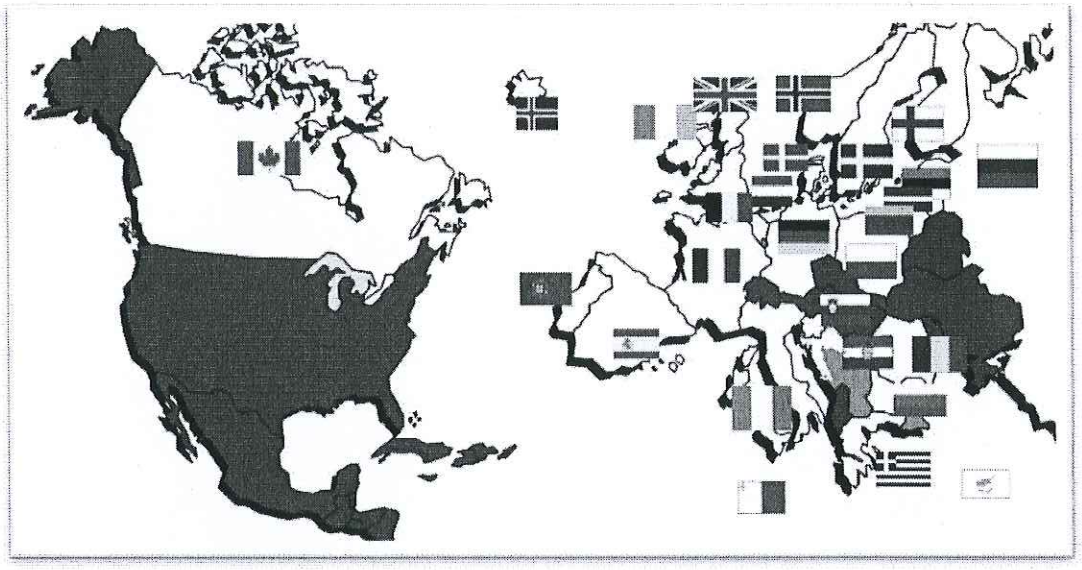

Figure 2.11 Regional Scope of Paris MoU (Source: www.parismou.org)

The managerial frame of the Paris MoU is the PSC Committee. It consists of the legislatures of the 27 contributing nautical authorities and the European Commission. The PSC Committee assembles once year, or at shorter interims if required. Legislatures of the IMO and the ILO join as observers in the assemblies of the PSC Committee, as well as legislatures of numerous collaborating Maritime Authorities and additional regional memorandums on port State control. The Committee deals with subjects of strategy, economics and management and is supported by technical frames established within the organization.

The MoU Advisory Board (MAB) supports the PSC Committee in centring on key topics, and in specific guides the Secretariat or the Paris MoU between Port State Control Committee meetings. Figure 2.12 provides organisational structure of Paris MoU.

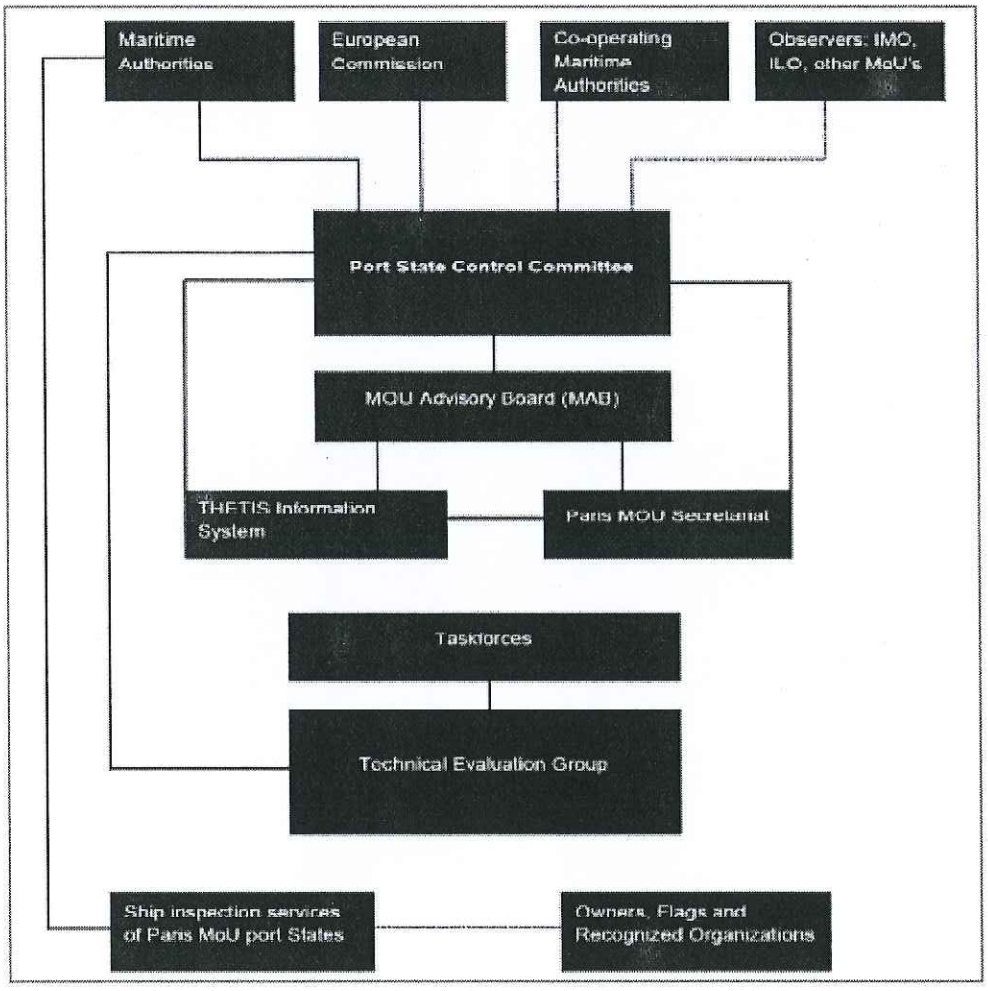

Figure 2.12 Organisation Structure of Paris MoU (Source: www.parismou.org)

The Secretariat Paris MoU on PSC is responsible for the effective application of the Paris MoU. The Secretariat is based in The Netherlands at The Hague. The Secretariat organizes international meetings and participates in various working groups. Furthermore, it is responsible for the exchange of information and serves as first contact point for the member States and external contacts.

2.2.2. Relevant Instruments to Paris MoU

The scope of the Port State Control within Paris MoU is identified under frame of international conventions/agreements which are listed in relevant instruments. According to Paris MoU agreement including 39th amendment which is accepted in 27 May 2016 and become effective by 1 July 2016; relevant instruments are listed as: (Paris MoU section 2.1)

1. "International Convention on Load Lines, 1966 (LOAD LINES 66);
2. Protocol of 1988 relating to the International Convention on Load Lines, 1966 (LL PROT 88);
3. International Convention for the Safety of Life at Sea, 1974 (SOLAS);
4. Protocol of 1978 relating to the International Convention for the Safety of Life at Sea, 1974 (SOLAS PROT 78);
5. Protocol of 1988 relating to the International Convention for the Safety of Life at Sea, 1974 (SOLAS PROT 88);
6. International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, and as further amended by the Protocol of 1997 (MARPOL);
7. International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW 78);
8. Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREG 72);
9. International Convention on Tonnage Measurement of Ships, 1969 (TONNAGE 69);
10. Merchant Shipping (Minimum Standards) Convention, 1976 (ILO Convention No. 147) (ILO 147);
11. Protocol of 1996 to the Merchant Shipping (Minimum Standards) Convention, 1976 (ILO Convention No. 147) (ILO P147)
12. Maritime Labour Convention, 2006 (MLC, 2006);
13. International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC1969);
14. Protocol of 1992 to amend the International Convention on Civil Liability for Oil Pollution Damage, 1969 (CLC PROT 1992);
15. International Convention on the Control of Harmful Anti-Fouling Systems on Ships, 2001 (AFS2001);
16. International Convention on Civil Liability for Bunker Oil Pollution Damage, 2001;
17. International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM)"

2.2.3. Ships of Non-Parties and Below Convention Size

Inspection procedure for the ships of non-parties and below convention size is identified in Annex 1 of the Memorandum of Understanding. According to Annex 1 of Paris MoU;

"Ships entitled to fly the flag of a State which is not a Party to a relevant instrument and thus not provided with certificates representing prima facie evidence of satisfactory conditions on board, or manned with crew members who do not hold valid STCW certificates, calling at a Paris MoU port of a member State which is Party to that relevant instrument, will receive a more detailed or, as appropriate, expanded inspection. In making such an inspection the Port State Control Officer will follow the same procedures as provided for ships to which the relevant instruments are applicable. If the ship or the crew has some alternative form of certification, the Port State Control Officer, in making this inspection, may take the form and content of this documentation into account."

Each convention which are listed in relevant instrument signifies a size threshold for application. These size limits vary by convention and ship types. Annex 1 of Paris MoU signifies the inspection process for vessels under convention size as;

"To the extent a relevant instrument is not applicable to a ship below convention size, the Port State Control Officer's task will be to assess whether the ship is of an acceptable standard in regard to safety, health or the environment. In making that assessment, the Port State Control Officer will take due account of such factors as the length and nature of the intended voyage or service, the size and type of the ship, the equipment provided and the nature of the cargo. In the exercise of his functions the Port State Control Officer will be guided by any certificates and other documents issued by or on behalf of the flag State Administration. The Port State Control Officer will, in the light of such certificates and documents and in his general impression of the ship, use his professional judgement in deciding whether and in what respects the ship will be further inspected."

2.2.4. Information System on Inspections

The central information system "THETIS" provides information on vessels details and rumours of earlier inspections performed within the Paris MoU area.(parismou.org) The database is housed by the European Maritime Safety Agency (EMSA). The system assists both the EU Community and the broader area of the Paris Memorandum of Understanding on PSC (Paris MOU) which takes in Iceland, Canada, the Russian Federation and Norway. This data structure is critical for the application of the new Port State Control inspection regime (NIR). (www.emsa.europa.eu)

THETIS designates which vessels have priority for examination and presents the marks of inspections to be logged. Through THETIS those logs are made accessible to other PSC authorities in the EU and the Paris MoU. THETIS also interfaces with numerous other maritime safety-associated databases as well as those of the EU-recognised classification societies, EU and national data structures and other port State control administrations so as to interchange information and deliver a full picture for the PSCO. Inspection outcomes are also accessible through a open website.

Each year 18 000 examinations are logged in the database which are performed by 600 approved operators from twenty-seven associated states. Everyday more than three thousand arrivals at all ports in the area are logged in the structure. (www.emsa.europa.eu)

2.2.5. Recognized Organizations (ROs)

To succeed for the standards "recognized by the Paris MoU", the organization has to be accepted by one or more Paris MoU member States. Table 2.1 provides a list of "Recognized Organizations" which is published on Paris MoU web site.

Even though there are 15 classification societies which are recognized by Paris MoU, ships which carry certificates of other classification societies may call at European ports. Paris publishes performance of all certificate issuer organizations on its annual reports.

Name:	Acronym:
American Bureau of Shipping	ABS
Bureau Veritas	BV
China Classification Society	CCS
Croatian Register of Shipping	CRS
Det Norske Veritas	DNV
DNV GL AS	DNV GL
Germanischer Lloyd	GL
Indian Register of Shipping	IRS
Korean Register of Shipping	KRS
Lloyd's Register of Shipping	LRS
Nippon Kaiji Kyokai	NKK
Polski Rejestr Statkow	PRS
Registro Italiano Navale	RINA
RINAVE Portuguesa	RP
Russian Maritime Register of Shipping	RMRS

Table 2.1 List of Recognized Organizations of Paris MoU (Source: Paris MoU 2016 Annual Report)

2.2.6. Targeting Criteria and New Inspection Regime (NIR)

Each day numerous vessels will be designated for a PSC inspection through the area. To enable this designation, the central computer database, namely 'THETIS' is referred by inspectors. The data structure, housed by the European Maritime Safety Agency, notifies national PSC authorities which vessels are due for an examination. Information on vessel details and intelligences of previous inspections performed within the Paris MoU area are delivered by the data structure too.

Every vessel in the data structure will be accredited a ship risk profile (SRP), in accordance with Annex 7 of the Paris MoU text. This SRP will regulate the vessels priority for examination, the interval between its examinations and the range of the examination. Vessels are allocated low, standard or high risk. This is based on nonspecific (ie. age, type of ship) and historic parameters (ie. recent inspections, detentions). SRP attribution criteria is shown on Table 2.2.

				Profile			
				High Risk Ship (HRS)		Standard Risk Ship (SRS)	Low Risk Ship (LRS)
Generic Parameters				Criteria	Weighting points	Criteria	Criteria
1	Type of ship			Chemical tankship Gas Carrier Oil tankship Bulk carrier Passenger ship	2	neither a high risk nor a low risk ship	All types
2	Age of ship[1]			all types > 12 y	1		All ages
3a	Flag	BGW-list[2]		Black - VHR, HR, M to HR	2		White
				Black – MR	1		
3b		IMO-Audit[3]		-	-		Yes
4a	Recognized Organization	Performance[4]	H	-	-		High
			M	-	-		-
			L	Low	1		-
			VL	Very Low			-
4b		Organizations recognized by one or more Paris MoU Member States		-	-		Yes
5	Company	Performance[5]	H	-	-		High
			M	-	-		-
			L	Low	2		-
			VL	Very Low			-
Historic Parameters							
6	Number of def. recorded in each insp. within previous 36 months	Deficiencies		Not eligible	-		≤ 5 (and at least one inspection carried out in previous 36 months)
7	Number of Detention within previous 36 months	Detentions		≥ 2 detentions	1		No Detention

Table 2.2 Ship Risk Profile Criterion (Source: Annex 7 of Paris MoU Text)

In accordance with New Inspection Regime, which has been effective since 2011, inspection intervals and priority levels are determined according to SRP. Inspection period and provision is determined in Annex 8 of Paris MoU. Periodic Examinations are performed at intervals decided according to the ship risk profile.

"For HRS – between 5-6 months after the last inspection in the Paris MoU region."

"For SRS – between 10-12 months after the last inspection in the Paris MoU region."

"For LRS – between 24-36 months after the last inspection in the Paris MoU region."

Unexpected or overriding factors may activate an examination in between routine examinations. This group of examination is mentioned as an Additional Inspection.

The group and type of examination performed is decided by the matrix in Table 2.3.

Priority	Level	Category of inspection
I Ship must be inspected	Overriding factor	Additional
	HRS not inspected in last 6 months	Periodic
	SRS not inspected in last 12 months	Periodic
	Ship not inspected in last 36 months	Periodic
II Ship may be inspected	HRS not inspected in last 5 months	Periodic
	Ship with unexpected factors	Additional
	SRS not inspected in last 10 months	Periodic
	LRS not inspected in last 24 months	Periodic

Table 2.3 Selection Scheme (Source: Annex 8 of Paris MoU Text)

2.2.7. Inspection Types and "Clear Grounds"

A PSC stay on board a vessel will usually initiate with, as a minimum and to the extent appropriate, inspection of the papers in accordance with Annex 10 of the Paris MOU. Additionally, the inspector performs a general examination of numerous zones on board to confirm that the general situation of the vessel fulfils the standards that required by the different documentations. If the vessel is found to fulfil, the inspector will release a 'clean' examination report to the master of the vessel. Whether deficits have been detected, the examination report will contain a deficits found report signifying any supplement activities to be taken to fix the deficits specified. (www.parismou.org)

There are three types of inspection in means of the scope of inspection which are regulated in Annex 9 of Paris MoU text. These are "initial", "more detailed" and

"expanded" inspections. In addition to these a Concentrated Inspection Campaign may extent the scope of inspection. The type of inspection to be performed is decided by Table 2.4 below:

Category of Inspection	Ship Risk Profile	Inspection Type		
		Initial	More detailed	Expanded
Periodic	HRS	NO	NO	YES
	SRS	YES	If clear grounds are found	If the ship is of a risk ship type[1] and more than 12 years old
	LRS			
Additional due to overriding or unexpected factor	All	NO	YES	According to the professional judgement of the PSCO if HRS or SRS/LRS of a risk ship type[1] and more than 12 years old

[1] risk ship types are chemical tanker, gas carrier, oil tanker, bulk carrier and passenger ship

Table 2.4 Inspection Type Determination Matrix (Source: Annex 9 of Paris MoU Text)

The term "Clear Grounds" means: "Evidence that the ship, its equipment, or its crew does not correspond substantially with the requirements of the relevant conventions or that the master or crew members are not familiar with essential shipboard procedures relating to the safety of ships or the prevention of pollution." (IMO resolution A.1052(27), Procedures for Port State Control, 2011)

2.2.7.1. Initial Inspections

İnitial inspection will consist of a call on board the vessel in order to:

- "check the certificates and documents listed in Annex 10";
- "check that the overall condition and hygiene of the ship including:"
    - "navigation bridge"
    - "accommodation and galley"
    - "decks including forecastle"
    - "cargo holds/area"
    - "engine room"

  meets commonly recognised worldwide regulations and criterion;
- "confirm, if it has not previously been done, whether any deficiencies found by an Authority at a previous inspection have been rectified in accordance with the time specified in the inspection report."

2.2.7.2. More Detailed Inspections

A more detailed inspection will be performed when there are clear grounds for considering, while an initial inspection, that the situation of the vessel or of its gear or crew or the living and working arrangements of seafarers does not significantly meet the appropriate necessities of a relevant instrument. Clear grounds will be present when a PSCO discovers indication, which in his specialized judgement warrants a more detailed inspection of the vessel, its crew or its gear. The lack of valid licenses or papers is considered a clear ground.

"A more detailed inspection will include an in-depth examination in:"

- "the areas where clear grounds are established"
- "the areas relevant to any overriding or unexpected factors"
- "other areas at random from the following risk areas:"

1. Documentation
2. Structural condition
3. Water/Watertight condition
4. Emergency systems
5. Radio communication
6. Cargo operations
7. Fire safety
8. Alarms
9. Living and working condition
10. Navigation equipment
11. Lifesaving appliances
12. Dangerous Goods
13. Propulsion and auxiliary machinery
14. Pollution prevention

2.2.7.3. Expanded Inspection

An expanded inspection will include a assessment of the general state, including the human element where applicable, in the subsequent risk areas:

1. Documentation

2. Structural condition
3. Water/Watertight condition
4. Emergency systems
5. Radio communication
6. Cargo operations including equipment
7. Fire safety
8. Alarms
9. Living and working conditions
10. Navigation equipment
11. Lifesaving appliances
12. Dangerous Goods
13. Propulsion and auxiliary machinery
14. Pollution prevention

and matter to their applied likelihood or any restraints connecting to the safety of crew, the vessel or the harbour, confirmation of the explicit items in those risk areas listed for every ship type.

The expanded inspection will consider the human elements concealed by STCW, ISM and ILO and include working controls as applicable. The PSCO must use specialised judgement to determine the suitable depth of inspection or testing of each particular item.

2.2.7.4. Concentrated Inspection Campaign (CIC)

Concentrated inspection campaigns focus on particular areas where high levels of deficits have been met by inspectors, or where new agreement requests have newly come into effect. Campaigns take place yearly over a period of 3 months (September - November) and are combined with a regular inspection.

2.2.8. Detention and Banning Procedures

2.2.8.1. Detention

According to Article 3.4 of Paris MoU text; Each Authority will endeavour to secure the rectification of all deficits noticed. In the case of "deficiencies which are clearly hazardous to safety, health or the environment", the Authority will guarantee that the threat is detached before the vessel is set to continue to sail. PSCO will use their professional expertise in determining the severity of deficiencies if they are "clearly hazardous to safety, health or the environment". Not to be let to sail to the sea because of the deficiencies is called "a detention". Normally the detention will end when the Authority ensure the deficiencies are all rectified. (Paris MoU Text)

On the state that all probable struggles have been made to fix all deficits, other than those which are obviously dangerous to security, health or the ecology, the ship can be permitted to proceed to a harbour where any such deficits can be repaired. Where deficits which triggered a detention cannot be fixed in the port of examination, the Authority may let the vessel concerned to go to the nearby suitable repair yard accessible.

2.2.8.2 Banning

"Banning" is the refusal of the access of a ship to the ports or anchorage areas by Maritime Authorities. Banning criteria is regulated in section 4 of the Paris MoU text.

A ship may face a banning in following circumstances;

- "a detained ship proceeds to sea without complying with the conditions determined by the Authority in the port of inspection,"
- "a detained ship which is directed to call to repair yard refuses to comply with the applicable requirements of the relevant instruments by not calling into the indicated repair yard."
- A ship which faced multiple detentions in a time period as explained below: "Each Authority is recommended to ensure that a foreign merchant ship is refused access to its ports and anchorages if it;"

- "flies the flag of a State appearing in the "grey list" as published in the annual report of the MoU and has been detained or has been issued with a prevention of operation order under the system of mandatory surveys for the safe operation of regular ro-ro ferry and highspeed passenger craft services more than twice in the course of the preceding "24 months" in a port or anchorage within the region of the Memorandum, or;"
- "flies the flag of a State appearing in the "black list" as published in the annual report of the MoU and has been detained or has been issued with a prevention of operation order under the system of mandatory surveys for the safe operation of regular ro-ro ferry and high-speed passenger craft services more than twice in the course of the preceding "36 months" in a port or anchorage within the region of the Memorandum"

The refusal of access order will be raised after a time of "three months" has elapsed from the date of issue of the instruction and when the circumstances are met. If the vessel is subject to a 2nd refusal of access, the period will be "12 months". Any following detention in a harbour or anchorage later the 3rd refusal of access will cause in the ship being "permanently" refused access to all harbours or anchorage.

2.2.8.3 Appealing Procedure

There are two type of appeal in Paris MoU region, which are namely "National Appeal" and "Detention Review".

When deficits are found which reduce the ship unhealthy to continue or that stances an irrational threat to the environment, the vessel will be detained. The inspector will issue a notification of detention to the master. The inspector will notify the master that the ship's owner/operator has the right of appeal. Appeal notification particulars can be found on the opposite side of the notification of the detention form and are different in the Paris MoU participant Countries. Appeal application procedures and deadlines vary by member States for example appeal may be done within 14 days from notice in Belgium whereas it may be done within 30 days in Canada. Details of the

"National Appeal" procedure can be found in official web site of the Paris MoU or at National Maritime Authorities.

In case an operator or owner declines to use the authorized National appeal process but still requests to criticize about a detention decision, such a criticism should be sent to the flag State or the Recognized Organization, which issued the legal Certificates on behalf of the flag State. The R.O. or flag State can then request the port State to reassess its decision to detain the vessel. If the R.O. or the flag State differs with the result of the investigation as stated above, an appeal for assessment can be sent to the Paris MOU Secretariat. This request can only be submitted by the flag State or the R.O., by "120 days from the date of release" of the ship from detention.

Section 3.12 of Paris MoU text clearly signifies that an appeal shall not cause the detention or refusal of access to be postponed.

2.3. EQUASIS MEMORANDUM OF UNDERSTANDING (MoU) AND INFORMATION SYSTEM

The role of the commerce in encouraging excellence and security in maritime transportation was at the core of the Quality Shipping Campaign, established by the European Commission and the UK Government by 1997 November. The Campaign's purpose was to get collected all parties involved in the different areas of maritime business in a struggle to advance marine safety. It was based upon discussion between all the maritime business and public establishments and its tools were, mainly, intended actions. As the Quality Shipping Campaign established, one of the biggest weaknesses to a genuine quality philosophy in shipping is the absence of transparency in the data concerning the excellence of vessels and their operators. (www.equasis.org)

While much applicable data is gathered and accessible, it is distributed and usually hard to reach. One of the key assumptions of the Quality Shipping Conference in Lisbon in 1998 June, was a unanimous call from the members representing the entire variety of business professionals (containing cargo owners, ship-owners, brokers, insurers, agents, classification societies, terminals and ports), to make such data more reachable.

In reply to this call, the French Maritime Administration and the European Commission decided to work together in developing a data structure which organises present safety-associated data on vessels from both open and secretive sources, and makes it accessible on the Internet.

The key doctrines related with the arrangement of the Equasis data structure were as:

- "Equasis should be a tool aimed at reducing substandard shipping, and it should be limited to safety-related information on ships;"
- "Equasis has no commercial purpose; it addresses a public concern and should act accordingly;"
- "Equasis should be an international database covering the whole world fleet;"
- "Active co-operation with all players involved in the maritime industry is needed;"
- "Equasis will be a tool used for better selection of ships, but it will be used on a voluntary basis and there will be no legal pressure for industry to use it."

The arrangement and operational process of Equasis will assist encourage the interchange of impartial data and transparency in marine transportation and thus let people involved in marine transportation to be healthier informed about the performance of vessels and marine societies with which they are working. The Equasis website became accessible on May 17th, 2000.

The present Memorandum of Understanding (MoU) for Equasis was signed on the 26th November 2015 in London by the following member states: Brazil, Canada, France, Japan, The Republic of Korea, Norway, the United Kingdom, Spain, and the United States of America. The MoU was also signed by the European Maritime Safety Agency (EMSA), acting as representative of the European Commission. At this stage the purpose of EQUASIS was widened to not only include safety and quality related data of the world commercial fleet, but also statutory ship data related to the protection of the environment. (www.equasis.org)

CHAPTER 3
"EXHAUSTIVE CHAID" ANALYSIS OF FACTORS THAT AFFECT DETENTION DURATION OF VESSELS IN PARIS MoU REGION

3.1. RESEARCH QUESTION:

Main purpose of this research is to find out which parameters play role in "Duration of a Detention" during PSC inspections. Detention of a ship cause a significant loss in profit for ship owners and other stakeholders. Key factor for loss of profit is "Duration of Detention". Ships' costs are classified as "running costs" and "fix costs". Fix costs consist of mainly crew expenses, vessel expenses, depreciation, amortization. All these expenses are dependent to time; journeys of the ship have no effect.

Another impact of detention is latency in following scheduled tasks such as delivery of cargo or missing a planned journey. Amount of loss through latency may vary by individual situation of each ship. However, duration of detention obviously will affect directly amount of latency costs.

Rectification of a deficiency is inevitable, however doing that at unexpected port where the detention had occurred will increase the cost of rectification. Furthermore, rectification which is done in an urgency situation will also increase the cost and decrease the efficiency of the action taken for deficiency. Amount of additional cost of rectification abroad may vary by situation of each ship, severity of the deficiency, opportunities of the detention port and accessibility of the ship managers to that port.

As it is described amount of the loss which is caused by a detention will mainly depend on duration of detention and some additional factors which are not observable and individually various.

From this point of view detention of a ship is a risk for loss of profit and main predictor of the amount of loss is "Duration of Detention". To be able to manage this risk factors, it is essential to measure which factors play role in duration of a detention.

Purpose of this research is to measure and classify the factors which affect "Duration of Detention" on Port State Control inspections. In this research it is tried to find the answer of following research questions;

Which parameters affect the duration of a detention during a PSC inspection?

Does duration of the detention vary by the port of inspection?

Do certain flags face significantly more detentions?

Does ownership nationality of ship have an effect in facing a detention?

Does ownership nationality of ship have an effect in duration of the detention?

Do Turkish owned ships face significantly more detentions?

To find out the answers of these questions, Paris Memorandum of Understanding (MoU) detention records used in analyses.

Why Paris MoU?

Paris MoU is the first regional agreement and it has consistent procedural implementation. Moreover, Paris MoU is one of the two major PSC regimes (with Tokyo MoU) which perform highest number of PSC inspections. To make it clear, by 2015; Paris MoU with Tokyo MoU performed 49.265 of 90.826 global inspections and 1748 of 2955 global detentions. Paris MoU and Tokyo MoU implementations are quite similar and they have high level of collaboration in means of standardisation. From Turkish point of view, Paris MoU is a closer and more frequented region than Tokyo MoU.

Among the data mining methodologies CHAID (Chi-squared Automatic Interaction Detection) model is selected. CHAID provides high level of flexibility. Prerequisites of CHAID are so minimal whereas other methods require some conditions such as "normal distribution" or "limited number of categories for nominal variables". CHAID also is robust against multicollinearity because methodology

analyses one variable on each iteration and only best predictor variable is taken account.

3.2 KEY STATISTICS OF INSPECTIONS IN PARIS MoU REGION

In this part; it will be a brief summary of detention statistics will be explained. Figure 3.1 and 3.2 demonstrate inspection numbers and individual ships inspected through last 10 years. It can be observed that after New Inspection Regime (NIR) entered into force after 1st of January 2011, number of inspections has decreased significantly while number of individual vessels examined has increased slightly. NIR, reduces the multiple inspections of ships and saves efforts of Port State Control Authorities.

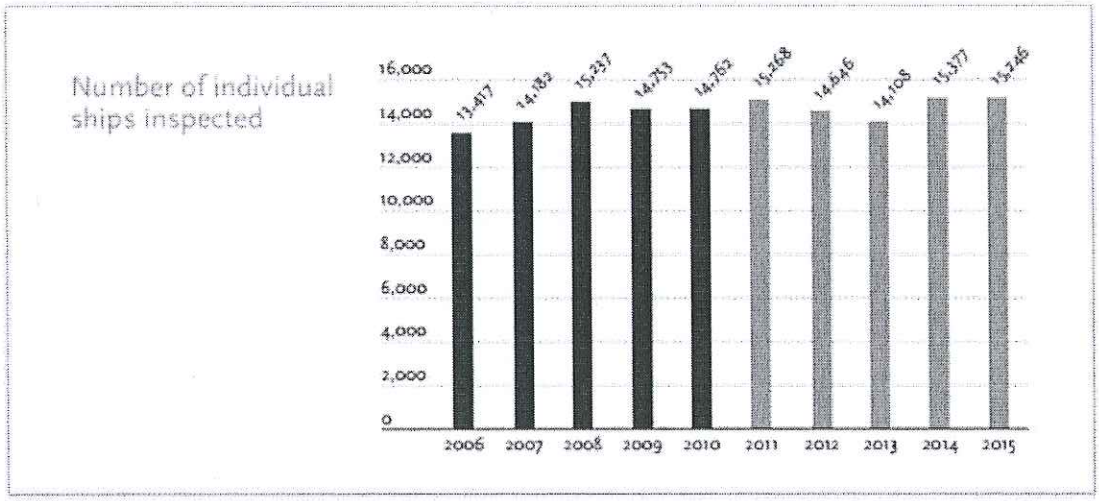

Figure 3.1 Numbers of Individual Ships Inspected in Paris MoU Within Last 10 Years (Source: 2015 Annual Report of Paris MoU)

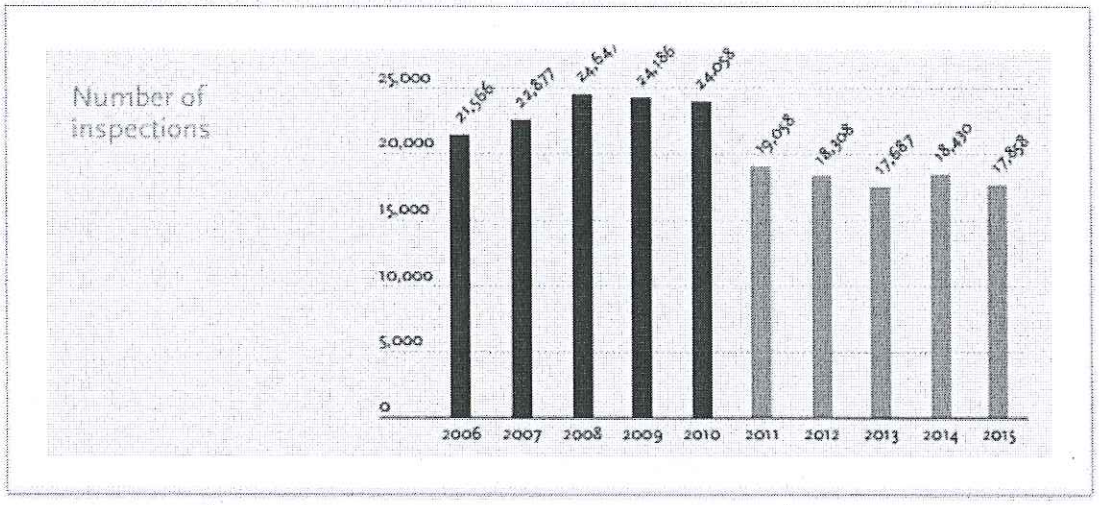

Figure 3.2 Number of Inspections Last 10 Years (Source: 2015 Ann. Rep. of Paris MoU)

Number of deficiencies detected are on Figure 3.3. It can be observed that there is a smooth decrease for last 5 years.

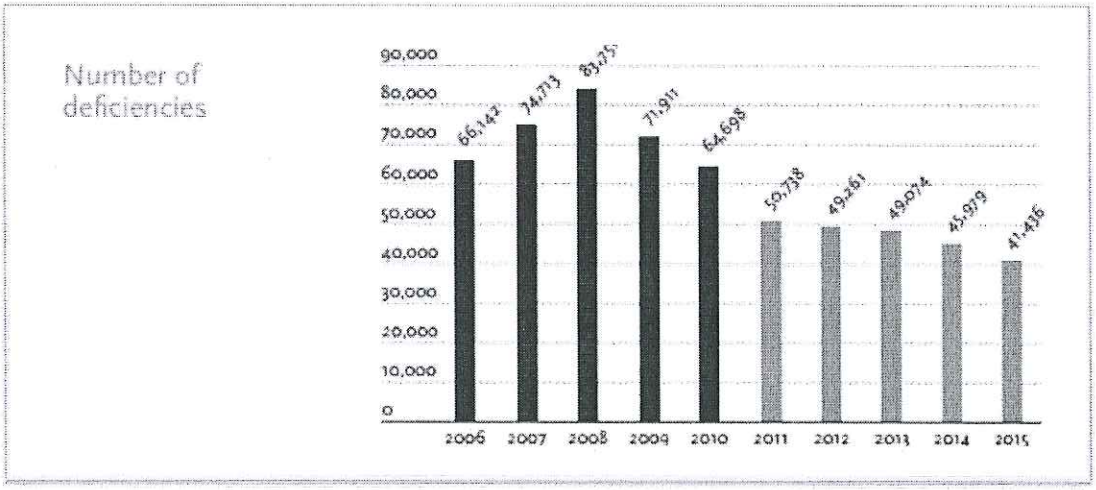

Figure 3.3 Number of Deficiencies Last 10 Years (Source: 2015 Ann. Rep. of Paris MoU)

In Figure 3.4 and Figure 3.5 detention percentage and number of detentions over number of inspections is seen. It can be said that, number of detentions and detention ratios are stable within last 5 years. By the NIR has entered into force in 2011, consequently the targeting of ships for inspection has changed. So inspection figures from 2011 onwards should not be compared to the ones from 2010 and before.

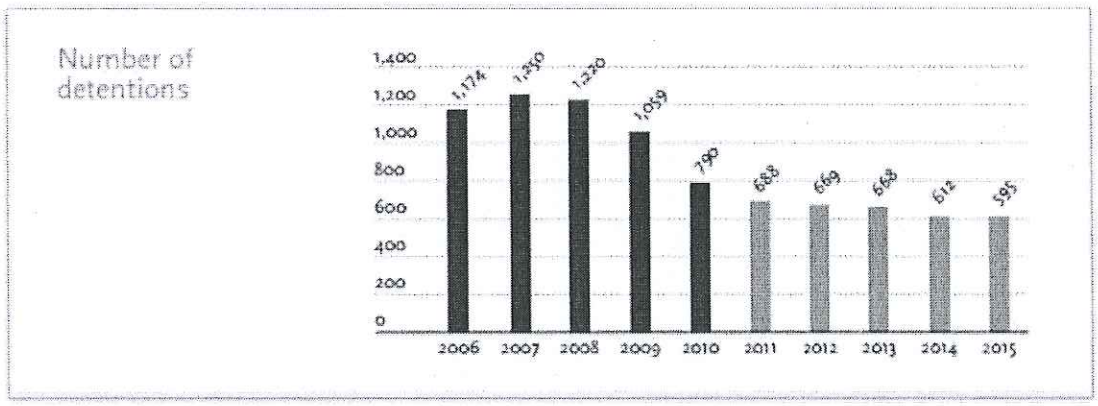

Figure 3.4 Number of Detentions Last 10 Years (Source: 2015 Ann. Rep. of Paris MoU)

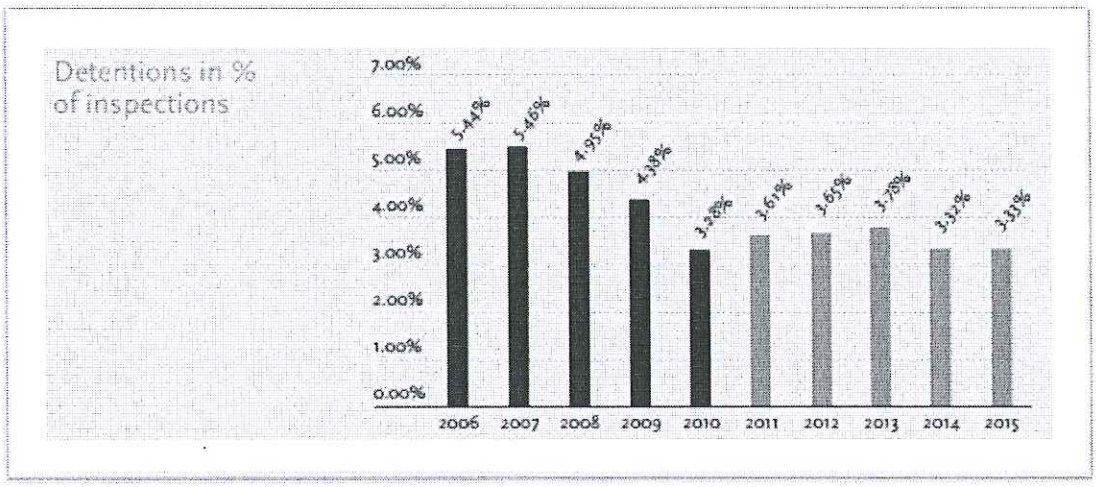

Figure 3.5 Detention Ratios Last 10 Years (Source: 2015 Annual Report of Paris MoU)

Black/Grey/White flag lists and unlisted flags of Paris MoU was explained in Chapter 2. Percentages of each lists within total inspections are demonstrated in Figure 3.6.

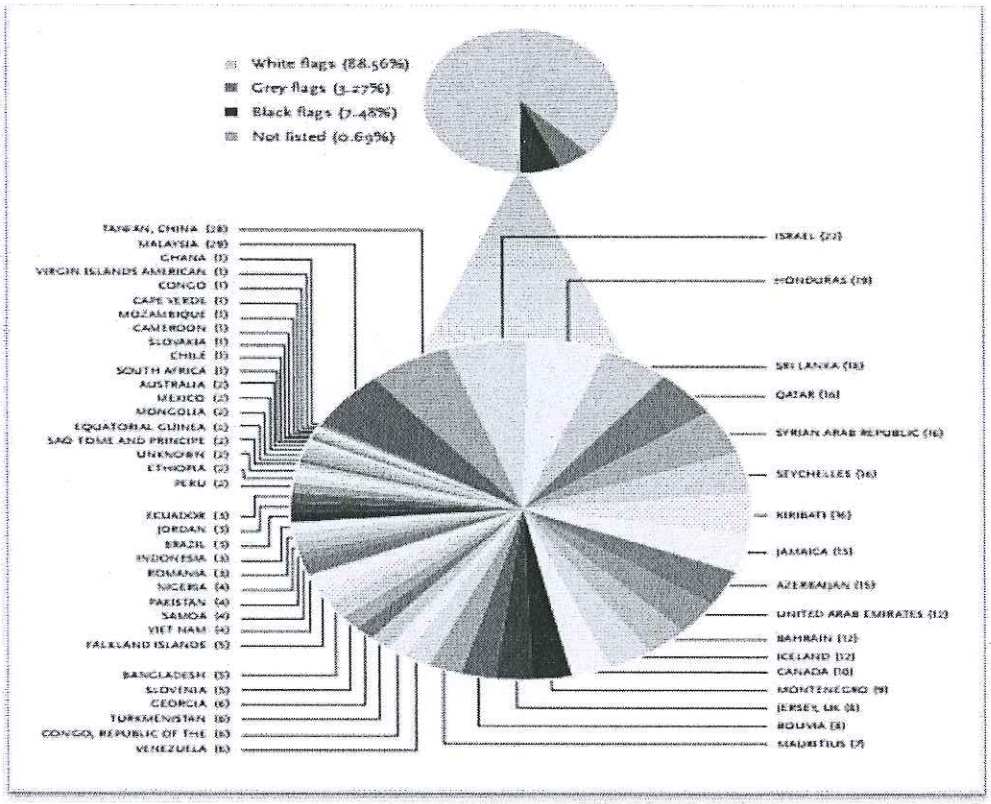

Figure 3.6 Black/Grey/White and Unlisted Flags (Source: 2015 Ann. Rep. of Paris MoU)

3.3. DESCRIPTION OF DATASET

The data set gathered from observation of 1.824 detention occasions in Paris MoU region, between January 2014 and November 2016 (35 months). All of the detention occasions are included in analysis, so there is no sampling application in analysed data. Paris MoU Authority publishes the monthly records of detention through official web site of organisation. In addition to Paris MoU data, ownership nationality information for each case manually collected from "Equasis" data base.

According to Paris MoU region inspection policy; Ship Risk Profile plays key role in deciding to inspection type which will be applied to ship. Ship Risk Profile is determined by generic parameters such as ship type, age and flag in addition to recent inspection performance which covers last 36 months. However, published data on Paris MoU web site concerning monthly detention statistics differ in scope and format before January 2014. Because of this differentiation in data, research data was kept in

coverage of last 35 months, data of December 2016 was not published yet by the date of research.

Data set had been gathered from monthly published detention lists on Paris MoU official web site and combined as a single list. List of variables and descriptions are listed on Table 3.1. IBM SPSS data analysis software is used in data analysis process.

VARIABLE NAME	DESCRIPTION OF VARIABLE	VALUE FORMAT	VALUE TYPE
ISMc_	Company Name and Country According to ISM	String	Nominal
SHIP_IMO	IMO Number	String	Nominal
CERT_IssuingAuthority_Descr	Classification Authority	String	Nominal
SHIP_Name	Name of Ship	String	Nominal
Charterer_name	Name of Charterer, if the ship is chartered.	String	Nominal
TotalDET36 mths	Number of detentions in Paris MoU Region within 36 months.	Numeric	Scale
Ship_Type	Type of Ship	String	Nominal
MAN_COUNTRY	Managing Country	String	Nominal
SHIP_FLAG	Flag state of ship.	String	Nominal
SHIP_GrossTonnage	Gross Tonnage of Ship	Numeric	Scale
SHIP_KeelDate	Keel Date Year of Ship	Numeric	Ordinal
ShipAge	Age of ship in the year of inspection.	Numeric	Scale
INSP_PlaceOfInspection	Inspection Port (place)	String	Nominal
Year of Release	Release date of detention Year	Numeric	Ordinal
Month of Release	Release date of detention Month	Numeric	Nominal
DET_DurationOfDetention	Duration of Detention	Numeric	Scale
Total Deficiencies	Total number of deficiencies detected during inspection	Numeric	Scale
Num_of_def_res_for_det	Number of deficiencies which are reason for detention	Numeric	Scale
Deficiencies	Deficiencies which are reason for	String	Nominal

	detention.		
Deficiency_title_code	Title codes of deficiencies according to Paris MoU deficiency codes. 28 Title Codes are selected from titles and subtitles of Deficiency Code List of Paris MoU. These are 28 binary variables where "1" stands for presence of deficiency title and "0" stands for absence.	Numeric	Nominal

Table 3.1 List of Variables

3.4. BASIC DESCRIPTIVE STATISTICS OF DETENTIONS

Table 3.2 provides a summary of continuous variables of data set which consists of "duration of detention", "age of ship", "number of total deficiencies", "number of deficiencies reason for detention", "gross tonnage" and "number of detentions within 36 months". It is seen that all these variables have very high range of values, this situation can be commented as there are too many extreme values for each variable. By comparing the maximum values and mean values it can be understood that most of the values are smaller than mean value. To minimize effects of this positive skewness of distribution, natural logarithm (Ln) of these values are used in analyses.

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
NUM. OF DET. WITHIN 36 MONTHS	1829	1,0	4,0	1,332	,6196
GROSS TONNAGE	1829	65	175343	11353,03	16389,301
AGE OF SHIP	1829	1,0	93,0	23,204	12,5410
DURATION OF DETENTION	1829	1	221	9,20	15,493
TOTAL NUMBER OF DEFICIENCIES	1829	1,0	81,0	13,599	8,7308
NUM. OF DEF. REASON FOR A DETENTION	1829	1,0	39,0	5,179	4,2497

Table 3.2 Descriptive Statistics of Continuous Variables

Top 10 Flag States within 91 different Flag States on detention lists of last 35 months are listed on Table 3.3 and percent shares are demonstrated on Figure 3.7. It is observed that most of ships fly open registry flags states and there are some national flags such as Russian Federation and Turkey. It has to be considered that total number of open registry flag ships are high too. Paris MoU considers the ratio of detentions over total inspections while determining Black/Grey/White flag lists.

FLAG STATE OF SHIP				
		Frequency	%	Cumm. %
1	Panama	299	16,3	16,3
2	Malta	126	6,9	23,2
3	Antigua and Barbuda	125	6,8	30,1
4	Liberia	124	6,8	36,9
5	Moldova, Republic of	81	4,4	41,3
6	Turkey	68	3,7	45,0
7	Togo	64	3,5	48,5
8	Russian Federation	60	3,3	51,8
9	Marshall Islands	51	2,8	54,6
10	Saint Vincent and the Grenadines	51	2,8	57,4

Table 3.3 Top 10 Flag States on Detention Lists

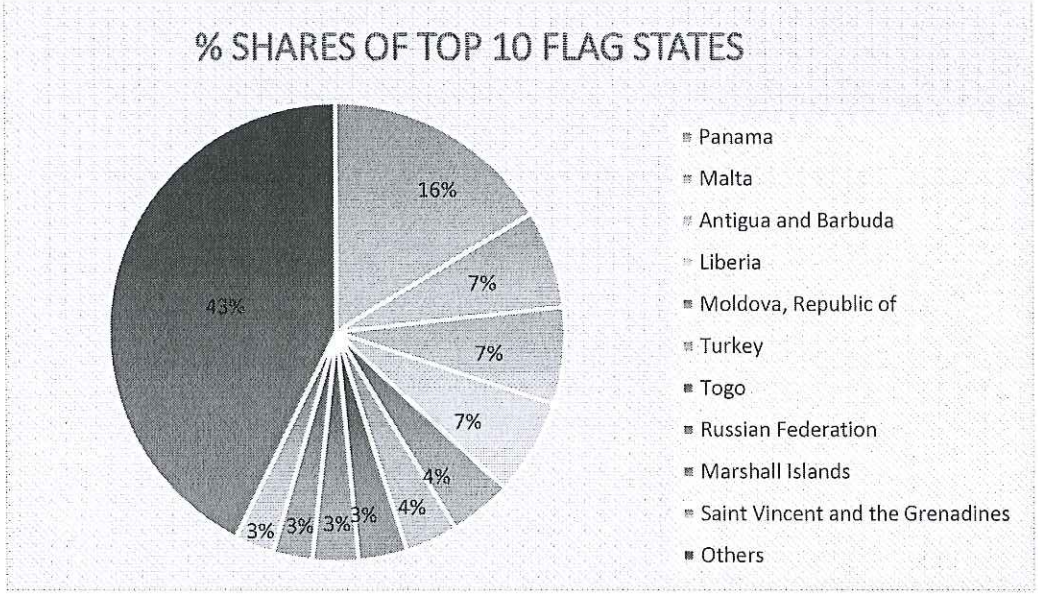

Figure 3.7 % Shares of Top 10 Flag States on Detention Lists

Figure 3.8 presents managing countries of detained ships. It can be said most of the detentions are done to ships which are owned or managed by a few specific countries. These countries are Turkey, Greece, Germany, Ukraine, Russian Federation and Lebanon. It has to be noted that to make a robust comparison we should know total number of inspected ships by their respective owner/managing countries. However total fleet sizes of these countries can give more understanding of this figure, it is presented on Table 3.4.

OWNER / MANAGING COUNTRIES			
	Frequency	%	Cum. %
TURKEY	308	16,8	16,8
GREECE	242	13,2	30,1
GERMANY	211	11,5	41,6
UKRAINE	128	7,0	48,6
RUSSIA	107	5,9	54,5
LEBANON	92	5,0	59,5
CHINA	66	3,6	63,1
NETHERLANDS	59	3,2	66,3
UK	45	2,5	68,8
ITALY	35	1,9	70,7
OTHERS	536	29,3	100,0

Figure 3.8 Owner / Managing Countries of Detained Ships

FLEET SIZES OF THE MOST FREQUENTED OWNER COUNTRIES OF DETAINED SHIPS			
	Number of Ships	Total DWT	% Share of World Fleet
GREECE	4.136	293.087.231	16,36
CHINA	4.960	158.884.367	8,87
GERMANY	3.361	119.181.405	6,65
UK	1.329	51.441.100	2,87
TURKEY	1.540	27.951.433	1,56
ITALY	802	22.739.369	1,27
RUSSIA	1.680	18.143.705	1,01
NETHERLANDS	1.229	17.441.092	0,97
UKRAINE	376	3.344.000	0,19
LEBANON	183	1.948.000	0,11

Table 3.4 Total Fleet Sizes of Subjected Countries (Source: UNCTAD, R.M.T. 2015)

Figure 3.9 and Table 3.5 provide information about share of ship types within 1829 detention occasions in last 35 months. (Jan 2014 through Nov 2016) It is seen that almost half of the ships are general cargo/multipurpose ships.

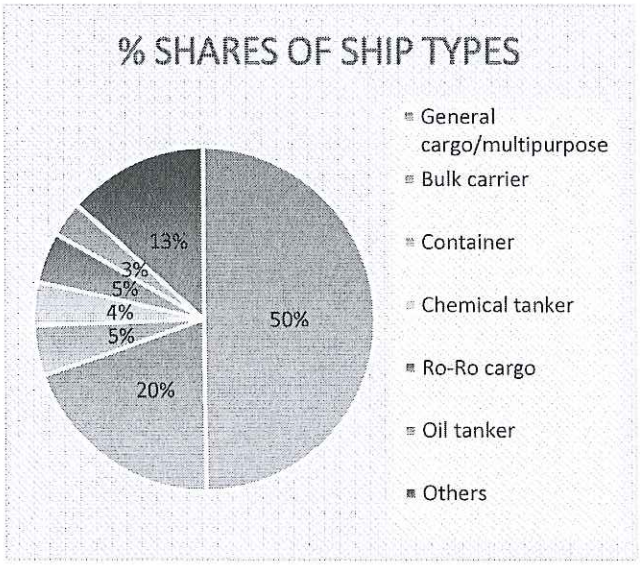

Figure 3.9 % Shares of Ship Types

	TYPE OF SHIP	Freq.	%
1	General cargo/multipurpose	912	49,9
2	Bulk carrier	362	19,8
3	Container	86	4,7
4	Chemical tanker	75	4,1
5	Ro-Ro cargo	87	3,6
6	Oil tanker	60	3,3
7	Others	247	13,5

Table 3.5 Ship Types

Figure 3.10 and Table 3.6 provide an overview of Certification Authorities of ships which are on detention lists during the observation period. Figures show most common 11 of 55 different Certification Authorities.

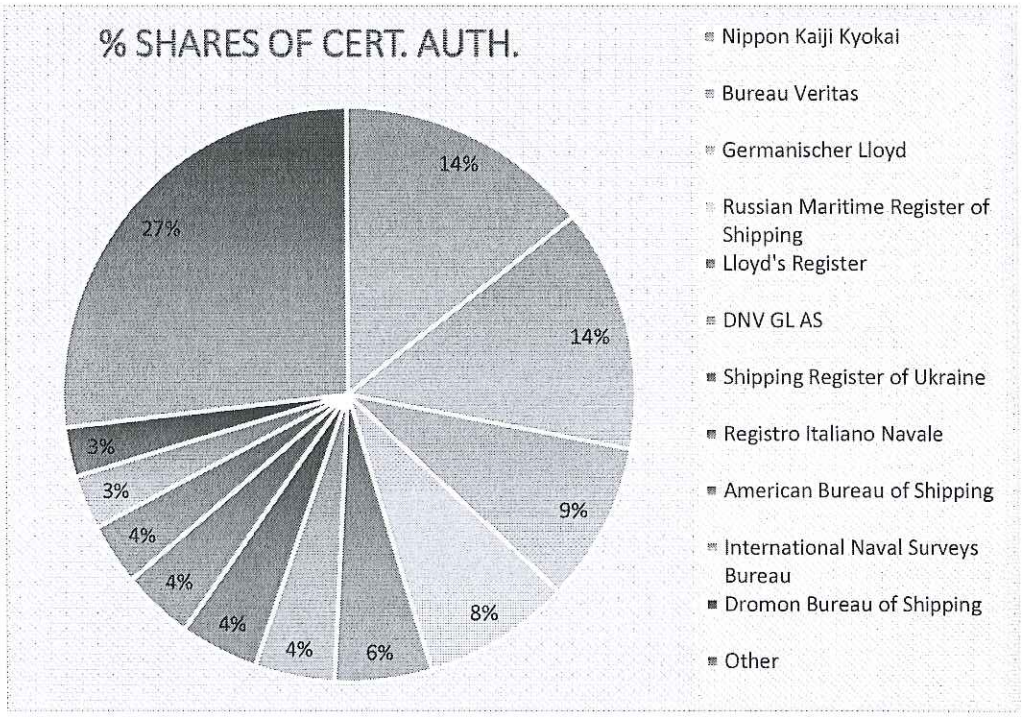

Figure 3.10 % Shares of Certification Authorities

	CERTIFICATION AUTHORITY	Freq.	%
1	Nippon Kaiji Kyokai	263	14,4
2	Bureau Veritas	250	13,7
3	Germanischer Lloyd	164	9,0
4	Russian Maritime Register of Shipping	152	8,3
5	Lloyd's Register	101	5,5
6	DNV GL AS	82	4,5
7	Shipping Register of Ukraine	81	4,4
8	Registro Italiano Navale	74	4,0
9	American Bureau of Shipping	64	3,5
10	International Naval Surveys Bureau	56	3,1
11	Dromon Bureau of Shipping	51	2,8
12	Others	491	26,8

Table 3.6 Certification Authorities

3.5. KEY STATISTICS OF DEFICIENCIES

According to basic analyses of data set we can see there are several reasons for a ship to be detained. It is observed that there are 367 unique reasons which are detected 9.468 times within 1.829 detention occasions from January 2014 to November 2016. Most common 10 reasons for a detention are shown on Table 3.7.

TOP 10 DEFICIENCIES				
		Frequency	Percent	Cumulative Percent
1	ISM	1036	10,9	10,9
2	Charts	289	3,1	14,0
3	Nautical publications	218	2,3	16,3
4	Fire drills	200	2,1	18,4
5	Fire doors/openings in fire-resisting divisions	185	2,0	20,4
6	Fire detection and alarm system	177	1,9	22,2
7	Emergency fire pump and its pipes	153	1,6	23,8
8	Fire-dampers	150	1,6	25,4
9	Emergency source of power - Emergency generator	148	1,6	27,0
10	Lifeboats	136	1,4	28,4

Table 3.7 Most Common 10 Deficiencies Reason for a Detention

Paris MoU Authorities categorize deficiencies in 18 titles and some titles have subtitles. In this research; titles and some subtitles are coded as binary variables where variable value of "1" stands for presence of that deficiency title and "0" stands for absence. Deficiency titles and defined variable names are shown in Table 3.8.

DEFICIENCY TITLE (Variable Label)	Variable Name
01 - Certificates & Documentation	
011 - Certificates & Documentation - Ship Certificate	@1100
012 - Certificates & Documentation - Crew Certificate	@1200
013 - Certificates and Documentation – Document	@1300
02 - Structural condition	@2100
03 - Water/Watertight condition	@3100
04 - Emergency Systems	@4100
05 - Radio communication	@5100
06 - Cargo operations including equipment	@6100
07 - Fire safety	@7100
08 - Alarms	@8100
09 - Working and Living Conditions	
091 - Working and Living Conditions - Living conditions	@9100
092 - Working and Living Conditions - Working Conditions	@9200
10 - Safety of Navigation	@10100
11 - Lifesaving appliances	@11100
12 - Dangerous Goods	@12100
13 - Propulsion and auxiliary machinery	@13100
14 - Pollution Prevention	
141 - Pollution Prevention - MARPOL Annex I	@14100
142 - Pollution Prevention - MARPOL Annex II	@14200
143 - Pollution Prevention - MARPOL Annex III	@14300
144 - Pollution Prevention - MARPOL Annex IV	@14400
145 - Pollution Prevention - MARPOL Annex V	@14500

146 - Pollution Prevention - MARPOL Annex VI	@14600
147 - Pollution Prevention - Anti Fouling	@14700
15 – ISM	@15100
16 – ISPS	@16100
18 - MLC, 2006	
181 - Minimum requirements to work on a ship	@18100
182 - Conditions of employment	@18200
183 - Accommodation, recreational facilities, food and catering	@18300
184 - Health protection, medical care, social security	@18400
99 – Other	@99100

Table 3.8. Deficiency Code Titles (Source: www.parismou.org)

Note: According to Paris MoU Deficiency Code Titles there is no title on number "17".

In this research all deficiencies are organized under 28 titles based on Paris MoU Deficiency Code titles. Table 3.9 provides frequencies of all 28 titles. It is seen that most common 5 titles consist more than half of the deficiencies.

	TITLE OF DEFICIENCY	Frequency	Percent	Cumulative Percent
1	Fire safety	1277	13,5	13,5
	Certificates&Documentation (Sum of 3 titles)	1194	13	-
2	Safety of Navigation	1170	12,4	25,8
3	ISM	1036	10,9	36,8
4	Emergency Systems	901	9,5	46,3
5	Lifesaving appliances	745	7,9	54,2
6	Certificates & Documentation - Ship Certificate	628	6,6	60,8
7	Propulsion and auxiliary machinery	520	5,5	66,3
8	Structural condition	449	4,7	71,0
9	Water/Weathertight condition	414	4,4	75,4
10	Certificates & Documentation - Crew Certificate	359	3,8	79,2
11	Working and Living Conditions - Working Conditions	334	3,5	82,7
12	Radio communication	293	3,1	85,8

13	Pollution Prevention - MARPOL Annex I	258	2,7	88,6
14	Certificates and Documentation - Document	207	2,2	90,7
15	Working and Living Conditions - Living conditions	181	1,9	92,6
16	Conditions of employment	178	1,9	94,5
17	Accommodation, recreational facilities, food and catering	115	1,2	95,7
18	Alarms	108	1,1	96,9
19	Health protection, medical care, social security	66	0,7	97,6
20	Pollution Prevention - MARPOL Annex VI	60	0,6	98,2
21	Pollution Prevention - MARPOL Annex IV	49	0,5	98,7
22	Other (@99100)	38	0,4	99,1
23	Cargo operations including equipment	32	0,3	99,5
24	Pollution Prevention - MARPOL Annex V	29	0,3	99,8
25	Dangerous Goods	8	0,1	99,9
26	Minimum requirements to work on a ship	7	0,1	99,9
27	Pollution Prevention - MARPOL Annex II	4	0,0	100,0
28	Pollution Prevention - Anti Fouling	2	0,0	100,0

Table 3.9 Distribution of Deficiencies By Titles.

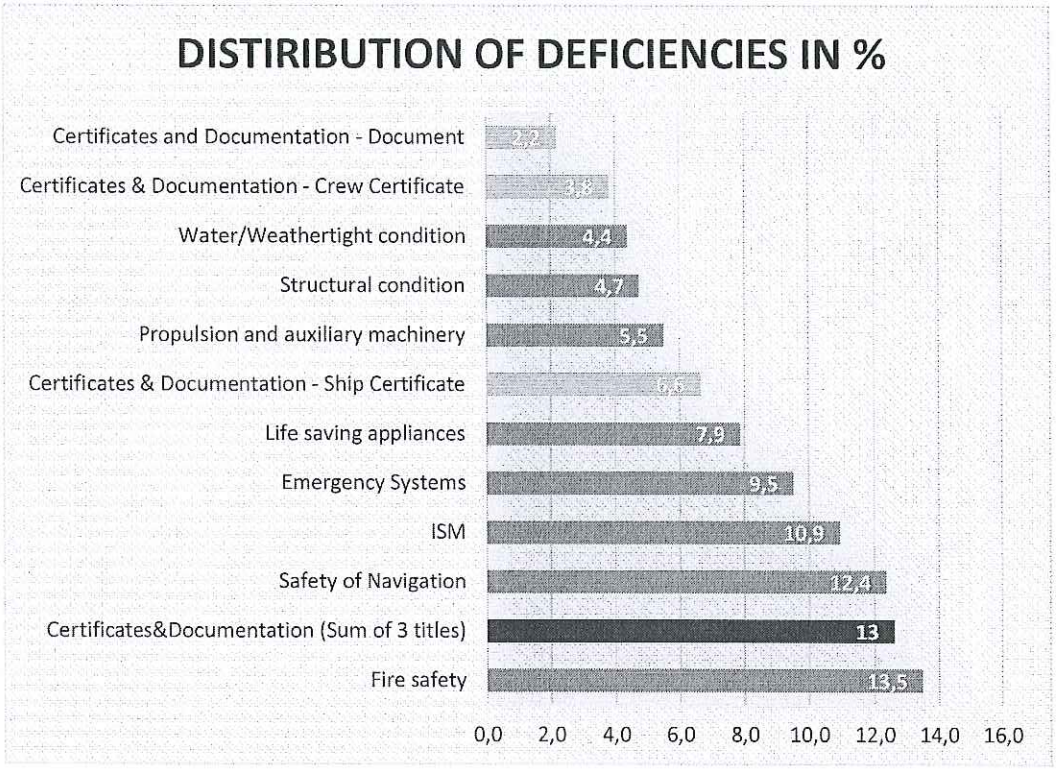

Figure 3.11 Distribution of Deficiency Titles in Percent

It should be noted that 3 subtitles of "Certificates&Documentation" is separated in analysis, where the sum of these three makes 12,6 % of all deficiencies.

3.5.1. Turkish Owned / Managed Ships

According to data set Turkish owned/managed ships faced 308 detentions during research period. During 308 detention occasions 4474 deficiencies are detected, in which 1603 of those are reason for detention. Frequency of deficiencies in 28 categories are presented on Table 3.10 and Figure 3.12.

TITLE OF DEFICIENCY				
		Frequency	Percent	Cumulative Percent
	Certificates&Documentation (Sum of 3 titles)	137	11,7	11,7
1	ISM	134	11,5	11,5
2	Fire safety	133	11,4	22,8
3	Emergency Systems	125	10,7	33,5
4	Safety of Navigation	122	10,4	44,0
5	Lifesaving appliances	78	6,7	50,6
6	Propulsion and auxiliary machinery	69	5,9	56,5
7	Certificates & Documentation - Crew Certificate	61	5,2	61,8
8	Water/Weathertight condition	50	4,3	66,0
9	Structural condition	49	4,2	70,2
10	Certificates & Documentation - Ship Certificate	46	3,9	74,2
11	Accommodation, recreational facilities, food and catering	46	3,9	78,1
12	Radio communication	41	3,5	81,6
13	Working and Living Conditions - Working Conditions	39	3,3	84,9
14	Conditions of employment	38	3,3	88,2
15	Pollution Prevention - MARPOL Annex I	37	3,2	91,4
16	Certificates and Documentation - Document	30	2,6	93,9

Table 3.10 Distribution of Deficiencies by Titles. (Turkish Owned/Managed Ships)

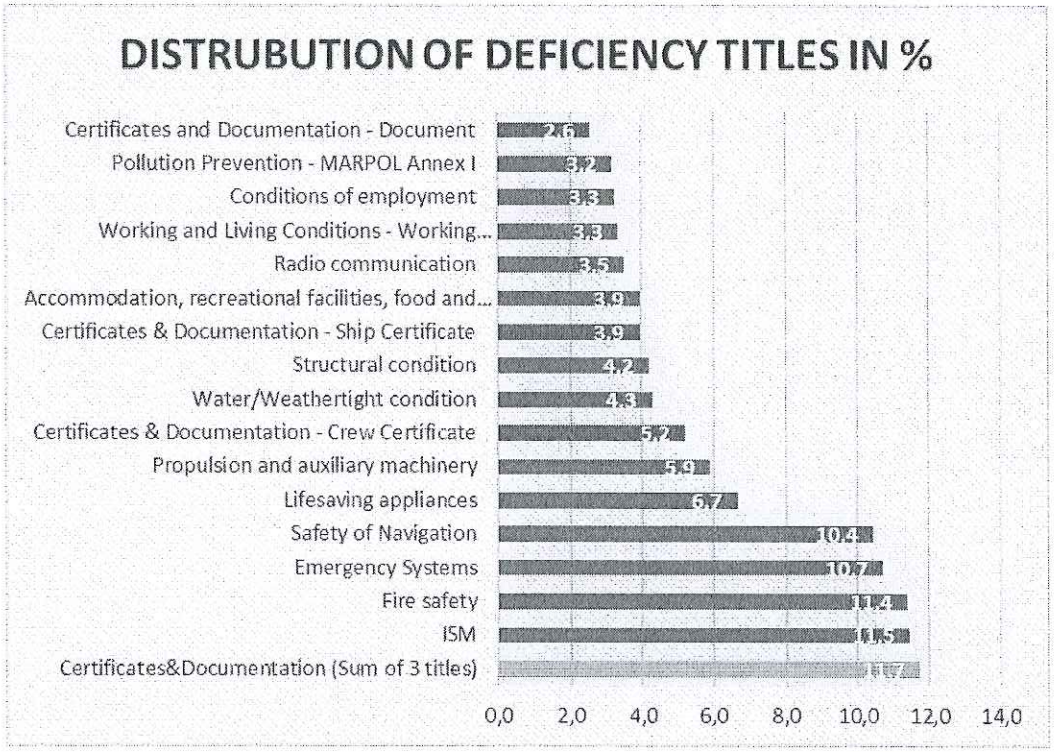

Figure 3.12 Distribution of Deficiency Titles in Percent (Turkish Owned/Managed Ships)

3.6. METHODOLOGY

Data is information that is invaluable on its own but it is used for an objective purpose. Whereas knowledge is data which is refined for intended purpose. (Barlas,2010,4) Knowledge is the answers derived from data. Data mining is the procedure of determining important new connections, trends and patterns by examining through big quantities of information stored in sources, using pattern recognition methodologies as well as mathematical and statistical techniques. (Larose, 2005,14) Data mining is the investigation of (often large) empirical data sets to find unanticipated relations and to summarize the information in original methods that are both comprehensible and beneficial to the information owner. (Hand, Mannila and Smyth,2001,1)

According to Larose, the most common data mining tasks are description, estimation, prediction, classification, clustering, association. (Larose,2005,30) In business, data mining is used for tasks such as analysing purchasing patterns to target sales campaigns and identify profitable customer types. (Thomas and Galombos, 2004,2)

Decision tree analysis and stepwise regression are used as data mining techniques to identify significant patterns in a many variable data set, rather than testing specific hypotheses about the effects of preselected variables. (Ibid, 4) A decision tree is a predictive model figured in the procedure of learning from occurrences, which may be observed as a tree. Each division of the tree is a classification question and the leaves of the tree are dividers of the data-set with their classification. (Anderica,2012,2) Starting point of the tree is called "Root Node" and Root node presents the whole data set. The nodes which are separated to branches are called parent nodes (or "internal node"). The node which are not separated are called terminal nodes (or "leafs"). Figure 3.13 visualizes the structure of a decision tree.

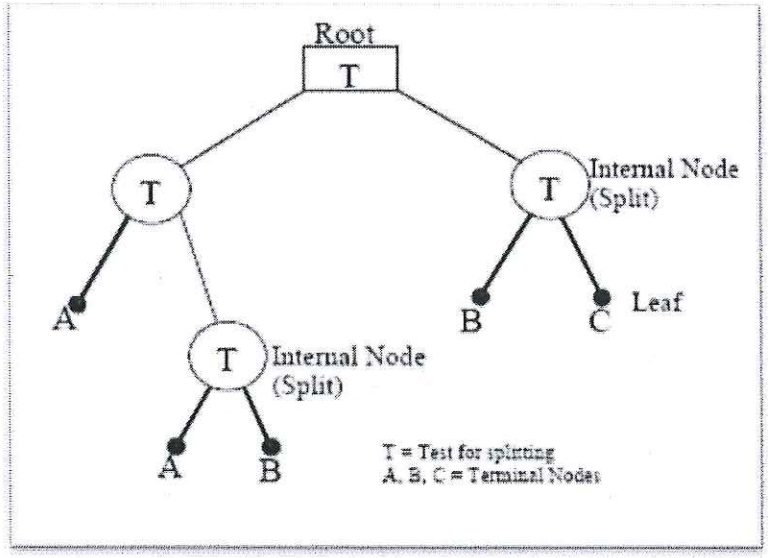

Figure 3.13 Structure of Decision Tree (Source: Morgan, 2014,5)

Research in classification and regression trees has seen rapid growth, and applications are increasing at an even greater rate. Interpretability of the tree structures is a strong reason for their popularity among practitioners, but so are reasonably good prediction accuracy, fast computation speed, and wide availability of software. (Loh, 2014,15) Decision trees are machine learning algorithms in which inputs and outputs of observed data are analysed and a prediction of outputs can be done by future situation inputs.

Automatic Interaction Detection (AID) of Morgan & Sonquist (1963) is the first regression tree algorithm published in the literature. (Loh, 2014,1) Starting at the root node, AID recursively splits the data in each node into two children nodes. (Thomas and Galombos,2004,2) THeta Automatic Interaction Detection (THAID) of Messenger & Mandell (1972) extends classification, in which Y is a categorical variable. THAID chooses splits to maximize the sum of the number of observations in each modal category. (Ibid) CHi-squared Automatic Interaction Detector (CHAID) of Kass (1980) is a modified version of earlier methods of AID and THAID. CHAID was originally designed for classification and later extended to regression. (Loh, 2014,16)

The primary concern of CHAID is to detect important interactions, not for improving prediction, but just to gain better knowledge about how the outcome variable is linked to the explanatory factors. (Ritschard, 2010,24) Some of other earlier tree

growing algorithms are Belson's proposal in 1959, ELISEE (Exploration of Links and Inter-actions through Segmentation of an Experimental Ensemble) by Cellard, Labbe, and Savitsky (1967), AID for multivariate quantitative outcome variables (MAID) by Gillo (1972), IDEA (Interactive Data Exploration and Analysis) by Press, Rogers, and Shure, Concept Learning Systems (CLS-1 to CLS-9) independently from those developments in the survey data analysis framework by Hunt, Marin and Stone (1966). (Ritschard, 2010) Figure 3.14 provides a comparison between CHAID and some other earlier tree growing algorithms.

	Local	Dependent variable		Splitting criterion		
Algorithm	split	quantitative	categorical	association	purity	p-value
Belson	binary		x	x		
AID	binary	x		x		
MAID	binary	x		x		
THAID	binary		x	x	x	
Hunt et al.	n-ary		x	x		
ELISEE	binary		x	x		
IDEA	n-ary	x	x	x		x
CHAID	n-ary	x	x	x		x

Figure 3.14 Comparison of Earlier Tree Growing Algorithms (Ritschard, 2010,6)

The motivation behind these first approaches is essentially to discover how the outcome variable is linked to the potential explanatory factors and more specifically to special configurations of factor values. Authors except Hunt are mainly interested in finding alternatives to the restrictions of the linear models. (Ibid,3)

CHAID is a model-free search procedure and its use involves the advantages and disadvantages of search procedures in general. It can be a very helpful means of reducing the complexity of relationships in a large data base, and can do so in a way that facilitates communication of the results. However, it relies on large samples and even with consequential differences in the data. Obviously, large probability samples also reduce the likelihood of chance relationships. Like any other search procedure or stepwise analysis (whether model-free or not), CHAID does have important limitations and users of the approach should be aware of them. First, the analysis may capitalize on chance because each variable is considered as a potential basis for splitting at each stage in the analysis. Clearly, this potential source of bias is larger when the sample is small. (Perreault and Barksdale,1980,6)

CHAID is especially suitable for use with categorical variables, and produces segments that are mutually exclusive and exhaustive by performing chi-square tests with Bonferroni adjustment. Thus, the CHAID algorithm aims to find a classification of population groups which is able to describe the dependent variable as well as possible. (Kass, 1980,3). Bonferroni adjustment is a multiplier for p-value which aims to reduce significant interaction detection by chance. Calculation procedure will be explained in algorithm details. The Bonferroni adjustment is employed to minimize Type I errors, but will only do so by increasing the probability of accepting the null hypothesis when the alternative is true, or Type II error. (Morgan, 2007,1)

3.6.1. CHAID Algorithm

CHAID procedure only admits nominal or ordinal categorical predictors. When predictors are scalable, they are converted automatically into ordinal predictors previously performing the CHAID algorithm. Default number of intervals is 10 where user can manually adjust the number of intervals. CHAID algorithm consists of 3 stages: merging, splitting and stopping. A tree is developed by continually using those 3 stages on every node starting from the root node. Splitting and stopping stages in Exhaustive CHAID algorithm are the identical as those in CHAID. Merging stage uses an exhaustive hunt process to merge any like pair until only one single pair residues. (IBM, SPSS Manual)

Merging Step:

For every predictor variable X, merge non-significant classifications. Each last category of X will outcome in one child node if X is used to split the node. The merging stage also computes the adjusted p-value that is to be used in the splitting step.

1. "If X has 1 category only, stop and set the adjusted p-value to be 1."
2. "Set index = 0. Calculate the p-value based on the set of categories of X at this time. Call the p-value p(index) = p(0)."
3. "Else, find the allowable pair of categories of X that is least significantly different (i.e.,most similar). This can be determined by the pair whose test statistic gives the largest p-value with respect to the dependent

variable Y. How to calculate p-value under various situations will be described in a later section."

4. "Merge the pair that gives the largest p-value into a compound category."
5. "(Optional) If the compound category just formed contains three or more original categories, search for a binary split of this compound category that gives the smallest p-value. If this p-value is larger than the one in forming the compound category by merging in the previous step, perform the binary split on that compound category."
6. "Update the index = index + 1, calculate the p-value based on the set of categories of X atthis time. Denote p(index) as the p-value."
7. "Repeat 3 to 6 until only two categories remain. Then among all the indices, find the set of categories such that p(index) is the smallest."
8. "(Optional) Any category having too few observations (as compared with a user-specified minimum segment size) is merged with the most similar other category as measured by the largest p-value."
9. "The adjusted p-value is computed by applying Bonferroni adjustments which are to be discussed in a later section."

Splitting Step:

The "best" split for respective predictor is found in the merging step. The splitting step chooses which predictor should be used to best split the node. Selection is accomplished by comparing the adjusted p-value related with respective predictor. The adjusted p-value is obtained in the merging step.

1. "Select the predictor that has the smallest adjusted p-value (i.e., most significant)."
2. "If this adjusted p-value is less than or equal to a user-specified alpha-level α_{split} (alpha split), split the node using this predictor. Else, do not split and the node is considered as a terminal node."

Stopping Step:

The stopping step checks if the tree developing procedure should be stopped according to the following stopping rules.

1. "If a node becomes pure; that is, all cases in a node have identical values of the dependent variable, the node will not be split."
2. "If all cases in a node have identical values for each predictor, the node will not be split."
3. "If the current tree depth reaches the user specified maximum tree depth limit value, the tree growing process will stop."
4. "If the size of a node is less than the user-specified minimum node size value, the node will not be split."
5. "If the split of a node results in a child node whose node size is less than the user specified minimum child node size value, child nodes that have too few cases (as compared with this minimum) will merge with the most similar child node as measured by the largest of the p-values. However, if the resulting number of child nodes is 1, the node will not be split."

The p-Value Calculations:

Calculations of (unadjusted) p-values in the mentioned procedures depend on the type of dependent variable. In this research dependent variable (Duration of Detention) is a continuous variable. Because of relevance of this research, only p-value calculation of continuous dependent variable will be explained. If the dependent variable *Y* is scale, performs an ANOVA F check that examines if the means of *Y* for different categories of *X* are the equal. This ANOVA F test computes the F-statistic and hence produces the p-value as;

$$F = \frac{\sum_{i=1}^{I}\sum_{n\in D} w_n f_n I(x_n = i)(\bar{y}_i - \bar{y})^2/(I-1)}{\sum_{i=1}^{I}\sum_{n\in D} w_n f_n I(x_n = i)(y_n - \bar{y}_i)^2/(N_f - I)},$$

$$p = \Pr\left(F(I-1, N_f - I) > F\right),$$

Where;

D denotes the relevant data which means the cases within a node.

Suppose in ***D*** there are ***I*** categories of ***X***,

x_n : Value of independent variable ***X*** in n'th observation,

y_n : Value of dependent variable ***Y*** in ***n***'th observation,

w_n : The case weight associated with case ***n***. There is no weight associated in this research so this multiplier will be equal to "1" in each process,

f_n : The frequency weight associated with case ***n***. There is no weight associated in this research so this multiplier will be equal to "1" in each process,

$$\bar{y}_i = \frac{\sum_{n\in D} w_n f_n y_n I(x_n = i)}{\sum_{n\in D} w_n f_n I(x_n = i)}, \quad \bar{y} = \frac{\sum_{n\in D} w_n f_n y_n}{\sum_{n\in D} w_n f_n}, \quad N_f = \sum_{n\in D} f_n,$$

and $F(I-1, N_f-I)$ is a random variable following a F-distribution with degrees of freedom ***I*** and N_f-I.

Benforrini Adjustment:

The adjusted p-value is computed as the p-value times a Bonferroni multiplier. The Bonferroni multiplier adjusts for several examinations. Assume that a predictor variable initially has ***I*** categories, Exhaustive CHAID merges two categories iteratively until only two categories left. The Bonferroni multiplier B is the sum of amount of probable ways of merging two categories at each iteration. Calculation will be done by following equation;

$$B = \begin{cases} \frac{I(I-1)}{2} & \text{Ordinal predictor} \\ \frac{I(I^2-1)}{2} & \text{Nominal predictor} \\ \frac{I(I-1)}{2} & \text{Ordinal with a missing category} \end{cases}$$

3.6.2. Demonstration of CHAID Algorithm

It would be useful for understanding the algorithm to be demonstrated in a schematic way. Figure 3.15 provides basic flow-chart of the algorithm.

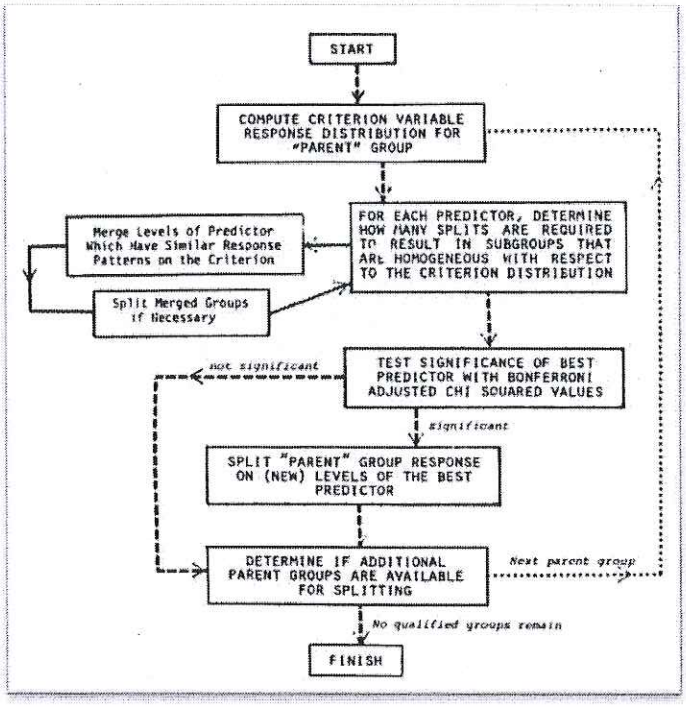

Figure 3.15 Analytic Flow of CHAID Algorithm (Perreault et al. 1980,4)

CHAID algorithm divides the universe where the dependent variable values vary significantly in means of independent variable values. If we think of a two-dimension universe CHAID will divide this universe according to distribution of dependent variable as seen in Figure 3.16. In this figure whole area within range of X_1 and X_2 forms the root node. Divided rectangles (R_1 to R_5) are the terminal nodes. Bigger rectangles which are compound of two or more terminal nodes (R_1+R_2 and R_4+R_5) are the parent nodes.

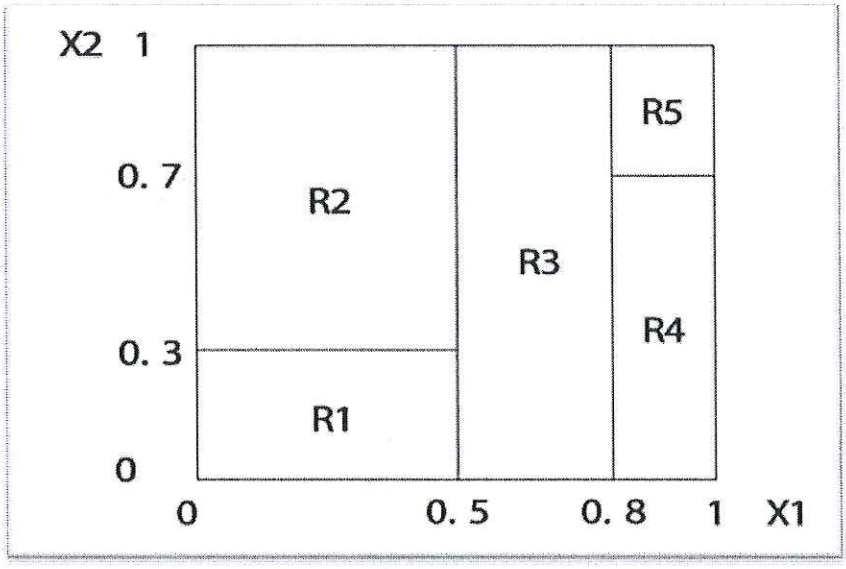

Figure 3.16 Division of Two-Dimension Universe by CHAID (Song and Lu, 2015,3)

To make it clear a simple example of CHAID application is demonstrated in Figure 3.17. In this figure the segmentation of iris flower is made by CHAID algorithm. There are two independent variables (petal length and width) and a categorical dependent variable. Setosa, Versicolour and Virginica are three species of iris. Numbers near each terminal node denote misclassified observations over accurate classification. Obviously there may be some other factors which affect the dimensions of iris petals such as the conditions of environment. In fact, this decision tree algorithm supplies sufficient segmentation rules to determine the specie of iris.

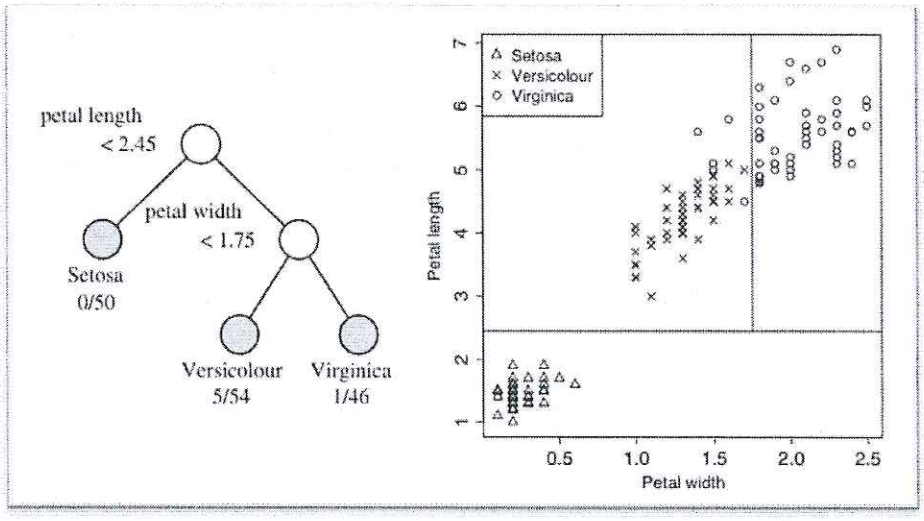

Figure 3.17 Classification of Iris Flower by Decision Tree Algorithm (Thomas and Galombos, 2004)

3.7. EXHAUSTIVE CHAID ANAYSIS OF PARIS MoU DETENTION DATA

3.7.1 Preparation of Data Set:

Before application of the Exhaustive CHAID algorithm, data set is divided by ship type. Ship type is highly determinative in inspection procedure where the check lists of different ship types vary significantly. And additionally characteristics of ships may affect the duration of a detention. This division resulted 7 groups of ships which is listed in Table 3.11.

No	Type of Ship	Number of Detentions	Share in %
1	General cargo/multipurpose	912	49,9
2	Bulk carrier	362	19,8
3	Container	86	4,7
4	Chemical tanker	75	4,1
5	Ro-Ro cargo	87	3,6
6	Oil tanker	60	3,3
7	Others	247	13,5
	Total	1829	100,0

Table 3.11 Distribution of Detentions by Ship Type

As it is mentioned before distributions of continuous variables are highly skewed, except "ship age" variable. Even though CHAID algorithm doesn't require a

normal distribution in variables, to minimize negative effects of skewness in distribution natural logarithms of values are used in the analysis. As a part of CHAID algorithm continuous independent variables will be transformed to ordinal structure. During this transformation, skewness of the distribution will obviously affect all intervals of the continuous variables. For each subdivision of the data set same procedure is applied. Skewness and kurtosis of continuous variables are shown in Table 3.12. In comparison of transformed values and untransformed values it can be seen that skewness and kurtosis of distribution reduced by log-normal (Ln) transformation, except in "Ship Age" variable. On the other hand, in "Chemical Tanker" group after transformation skewness and kurtosis of all variables reduced including "Ship Age" variable. According to Tabachnick and Fidell (2013), skewness and kurtosis should be between -1,5 and +1,5 to make a parametric analysis.

Minimum values of skewness and kurtosis values highlighted with bold characters will be used in analysis.

Before proceeding to analyses it has to be pointed out that there is an infirmity in the analysed data. As it is explained in the previous section that; type, scope and frequency of an inspection are determined by the Ship Risk Profile(SRP). SRP without doubt influence probability of detention and also duration of detention. However, Paris MoU detention data doesn't contain the information about the SRP status of ships just before detention. Readers should consider this infirmity of the population.

Descriptive Statistics													
SUBSET	VARIABLES	N	Min.	Max.	Mean	Skew.	Kurt.		Min.	Max.	Mean	Skew.	Kurt.
General Cargo	DURATION OF DETENTION	912	1	198	9,41	6,03	50,64	LN	0,00	5,29	1,77	**0,52**	**1,09**
	TOTAL NUMBER OF DEFICIENCIES	912	1	81	14,77	1,67	5,94	LN	0,00	4,39	2,51	**-0,84**	**1,59**
	NUM. OF DEF. REASON FOR A DETENTION	912	1	39	5,68	2,57	10,58	LN	0,00	3,66	1,46	**-0,18**	**-0,23**
	AGE OF SHIP	912	3	60	26,52	**-0,18**	**-0,80**	LN	1,10	4,09	3,15	**-1,12**	**0,59**
	GROSS TONNAGE	912	210	38716	3970,85	3,89	22,55	LN	5,35	10,56	8,06	**0,29**	**1,56**
Oil Tanker	DURATION OF DETENTION	60	1	115	11,82	3,75	17,59	LN	0,00	4,74	1,81	**0,44**	**-0,17**
	TOTAL NUMBER OF DEFICIENCIES	60	1	41	12,83	1,28	0,88	LN	0,00	3,71	2,20	**-0,66**	**0,39**
	NUM. OF DEF. REASON FOR A DETENTION	60	1	29	5,22	2,88	10,52	LN	0,00	3,37	1,26	**0,02**	**-0,69**
	AGE OF SHIP	60	1	68	22,65	**1,01**	**1,06**	LN	0,00	4,22	2,91	-1,24	3,44
	GROSS TONNAGE	60	179	164359	22284,17	2,35	6,50	LN	5,19	12,01	8,67	**0,14**	**-0,98**
Ro-Ro	DURATION OF DETENTION	87	1	221	11,54	5,95	38,08	LN	0,00	5,40	1,68	**1,01**	**2,38**
	TOTAL NUMBER OF DEFICIENCIES	87	1	46	13,98	1,28	2,07	LN	0,00	3,83	2,41	**-0,72**	**0,72**
	NUM. OF DEF. REASON FOR A DETENTION	87	1	18	6,18	0,99	0,14	LN	0,00	2,89	1,54	**-0,34**	**-0,57**
	AGE OF SHIP	87	2	55	25,31	**-0,07**	**-0,59**	LN	0,69	4,01	3,05	-1,43	1,80
	GROSS TONNAGE	87	443	100430	20580,62	1,41	2,07	LN	6,09	11,52	9,33	**-0,75**	**0,06**
Bulk	DURATION OF DETENTION	362	1	96	7,77	5,50	39,92	LN	0,00	4,56	1,67	**0,52**	**0,98**
	TOTAL NUMBER OF DEFICIENCIES	362	1	49	13,01	1,39	2,51	LN	0,00	3,89	2,35	**-0,58**	**0,56**
	NUM. OF DEF. REASON FOR A DETENTION	362	1	30	4,41	2,11	8,45	LN	0,00	3,40	1,18	**-0,08**	**-0,92**
	AGE OF SHIP	362	1	43	15,08	**0,63**	**-0,19**	LN	0,00	3,76	2,49	-0,83	0,64
	GROSS TONNAGE	362	3883	94934	26418,51	2,00	5,57	LN	8,26	11,46	10,02	**-0,18**	**0,50**
Container	DURATION OF DETENTION	86	1	66	5,69	5,57	37,38	LN	0,00	4,19	1,36	**0,92**	**1,67**
	TOTAL NUMBER OF DEFICIENCIES	86	1	38	11,17	1,11	1,09	LN	0,00	3,64	2,13	**-0,79**	**0,63**
	NUM. OF DEF. REASON FOR A DETENTION	86	1	14	4,44	1,29	1,27	LN	0,00	2,64	1,25	**-0,11**	**-0,66**
	AGE OF SHIP	86	4	28	14,27	**0,35**	**-0,79**	LN	1,39	3,33	2,58	-0,37	-0,45
	GROSS TONNAGE	86	3125	175343	27104,10	2,41	8,60	LN	8,05	12,07	9,80	**0,39**	**-0,83**
Chemical Tanker	DURATION OF DETENTION	75	1	113	7,96	4,87	26,25	LN	0,00	4,73	1,43	**1,47**	**2,79**
	TOTAL NUMBER OF DEFICIENCIES	75	1	40	9,79	1,71	3,30	LN	0,00	3,69	1,95	**-0,37**	**-0,20**
	NUM. OF DEF. REASON FOR A DETENTION	75	1	14	3,63	1,39	1,53	LN	0,00	2,64	0,99	**0,21**	**-1,03**
	AGE OF SHIP	75	2	50	14,27	1,89	4,70	LN	0,69	3,91	2,52	**-0,03**	**1,47**
	GROSS TONNAGE	75	457	30093	13139,36	0,50	-1,26	LN	6,12	10,31	9,11	**-0,59**	**-0,15**
Others	DURATION OF DETENTION	247	1	173	10,70	4,83	32,47	LN	0,00	5,15	1,72	**0,55**	**0,08**
	TOTAL NUMBER OF DEFICIENCIES	247	1	55	12,20	1,53	3,82	LN	0,00	4,01	2,27	**-0,79**	**0,86**
	NUM. OF DEF. REASON FOR A DETENTION	245	1	20	4,80	1,38	2,16	LN	0,00	3,00	1,30	**-0,16**	**-0,75**
	AGE OF SHIP	247	1	93	28,09	**0,23**	**0,29**	LN	0,00	4,53	3,11	-1,29	1,51
	GROSS TONNAGE	247	65	85616	4598,45	6,01	40,95	LN	4,17	11,36	7,34	**-0,02**	**-0,66**

Table 3.12 Descriptive Statistics Comparison of Transformed Variables

3.7.2 Exhaustive CHAID Analysis of Data Sets

Exhaustive CHAID analysis gives a decision tree output which demonstrates the classification rules and risk estimate value which provides a total variance (σ^2) in predicted values. IBM SPSS also keeps the "predicted values" as an additional variable of each case. Predicted values will be determined as the mean value within a terminal node.

On each node there is main descriptive statistics are presented which consist of mean value of dependent variable (Ln(Duration of Detention)), standard deviation (σ), number of cases in that respective node and share in percent over total cases and also a schematic mini histogram that provides distribution.

On each branch between nodes, there is the classification rule of splitting criteria with the results of significance test (which is ANOVA as the dependent variable is continuous).

To evaluate the performance of the decision tree, initial value of variance which is the square of standard deviation at the root node will be compared with the total variance estimate of which is an output of analysis.

While deciding the user specified criteria of minimum number of cases within a parent node and terminal node; it will be a search for maximum reduction in variance while keeping the tree in minimum size. As a result of tree growing process number of cases in terminal nodes will be reduced. This will make the tree useless because results should be generalizable. Even though there is no sampling process in the data set which means all of the cases are put in the analysis, while using this analysis for future prediction, past cases can be considered as the sample for sum of future and past cases.

Decision tree outputs of Exhausted CHAID analysis of data sets are presented in Figures 3.18 to 3.24.

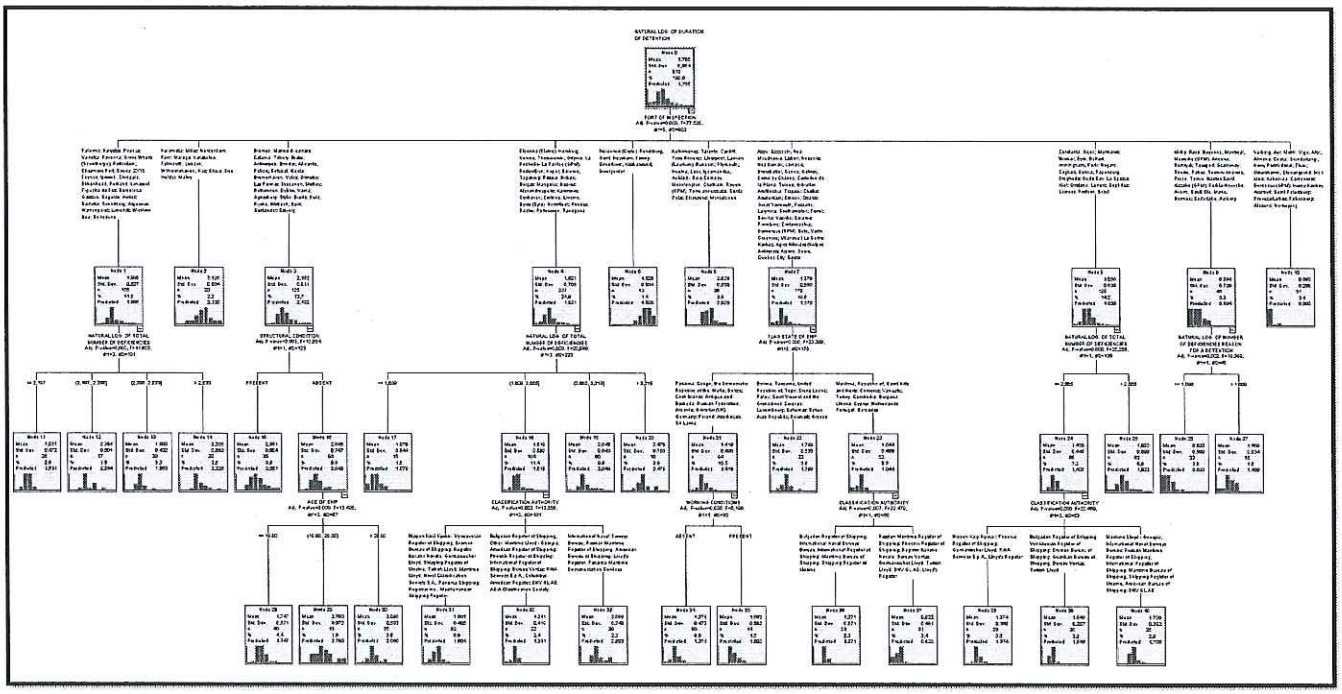

Figure 3.18 Exhaustive CHAID Tree for General Cargo

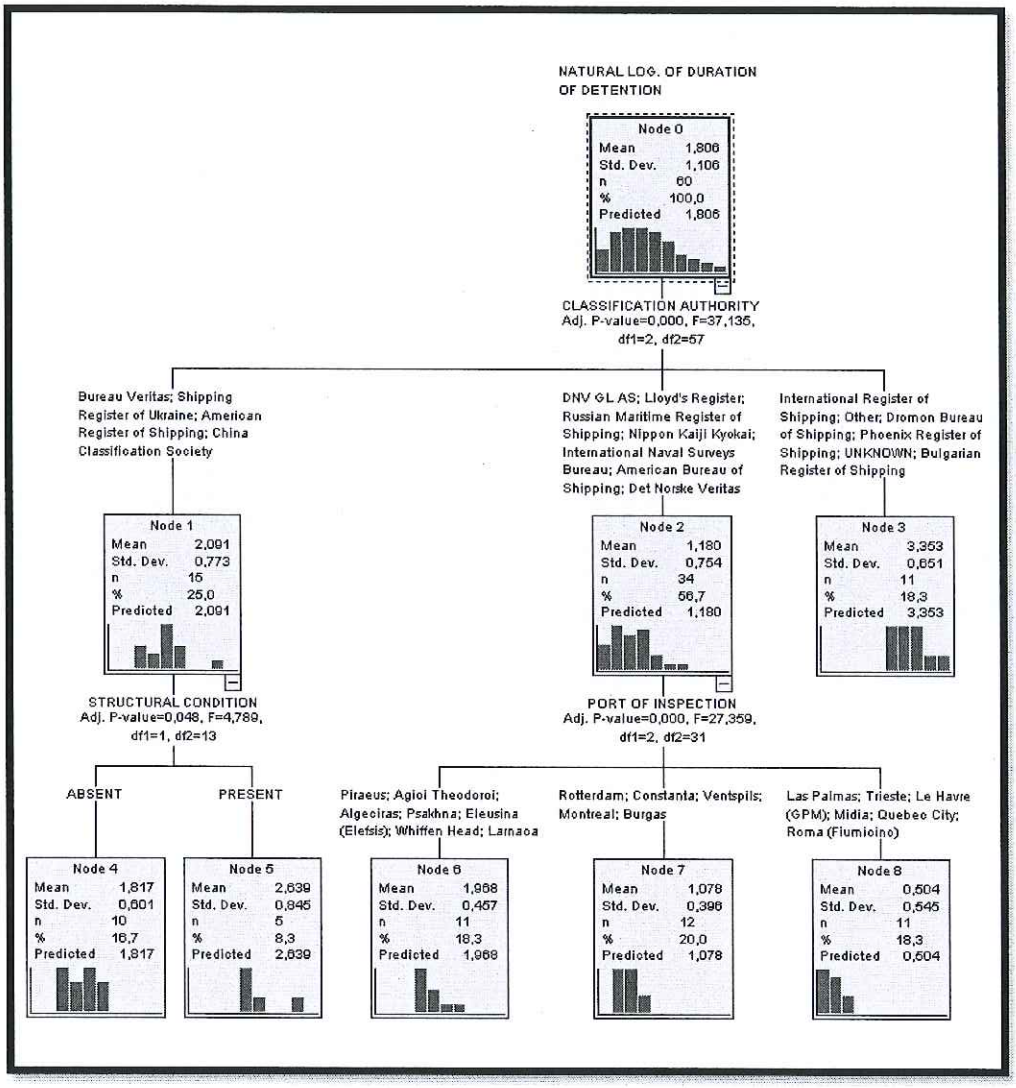

Figure 3.19 Exhaustive CHAID Tree for Oil Tanker

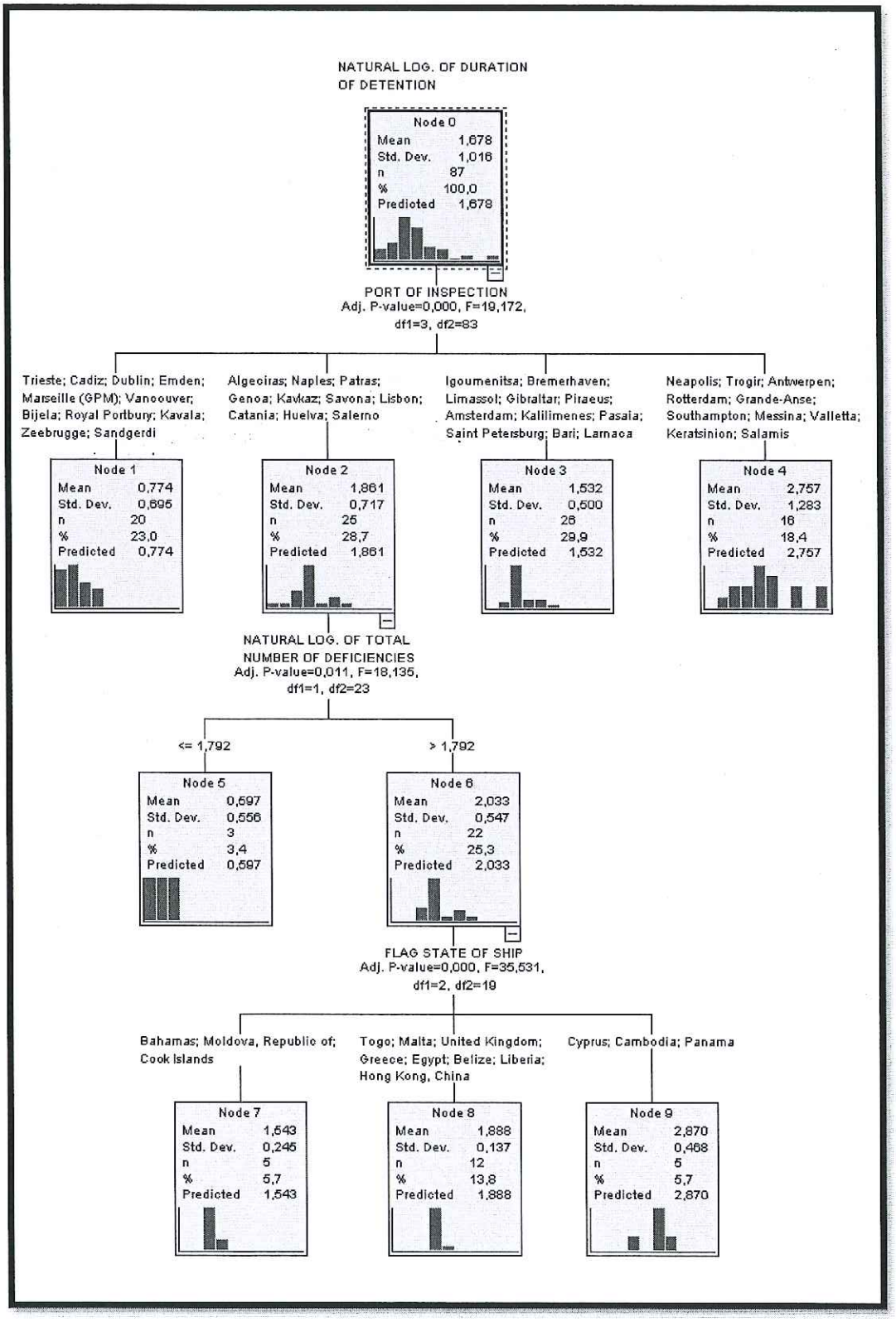

Figure 3.20 Exhaustive CHAID Tree for Ro-Ro

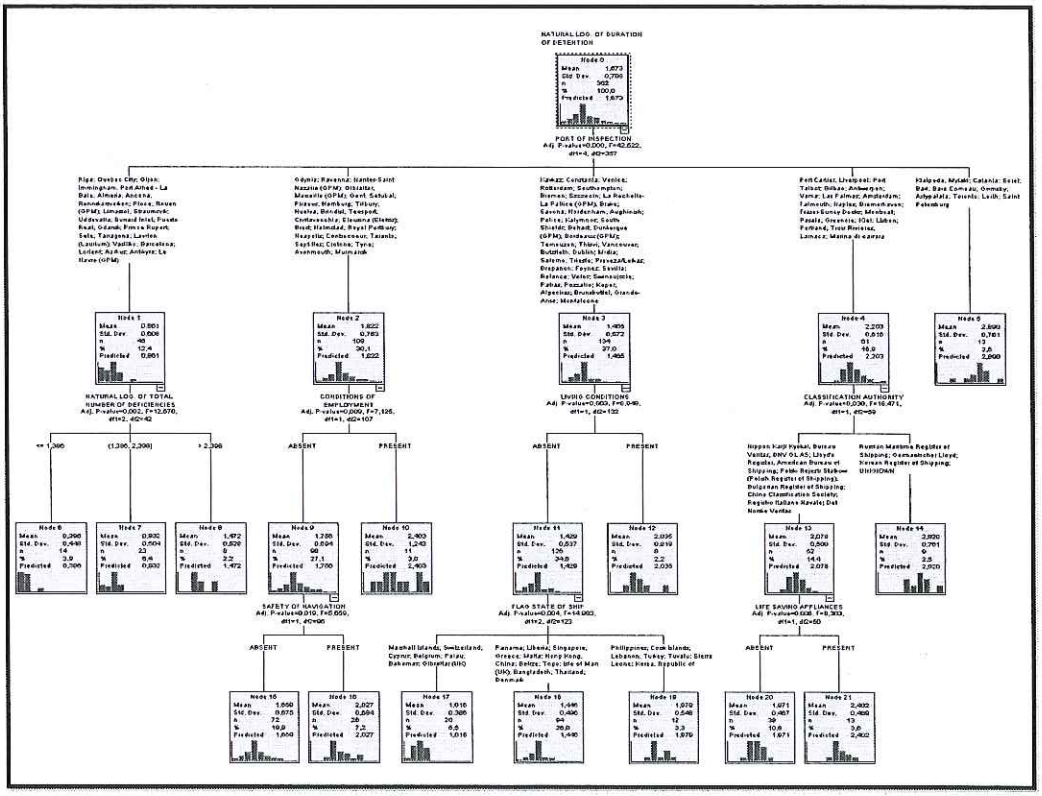

Figure 3.21 Exhaustive CHAID Tree for Bulk

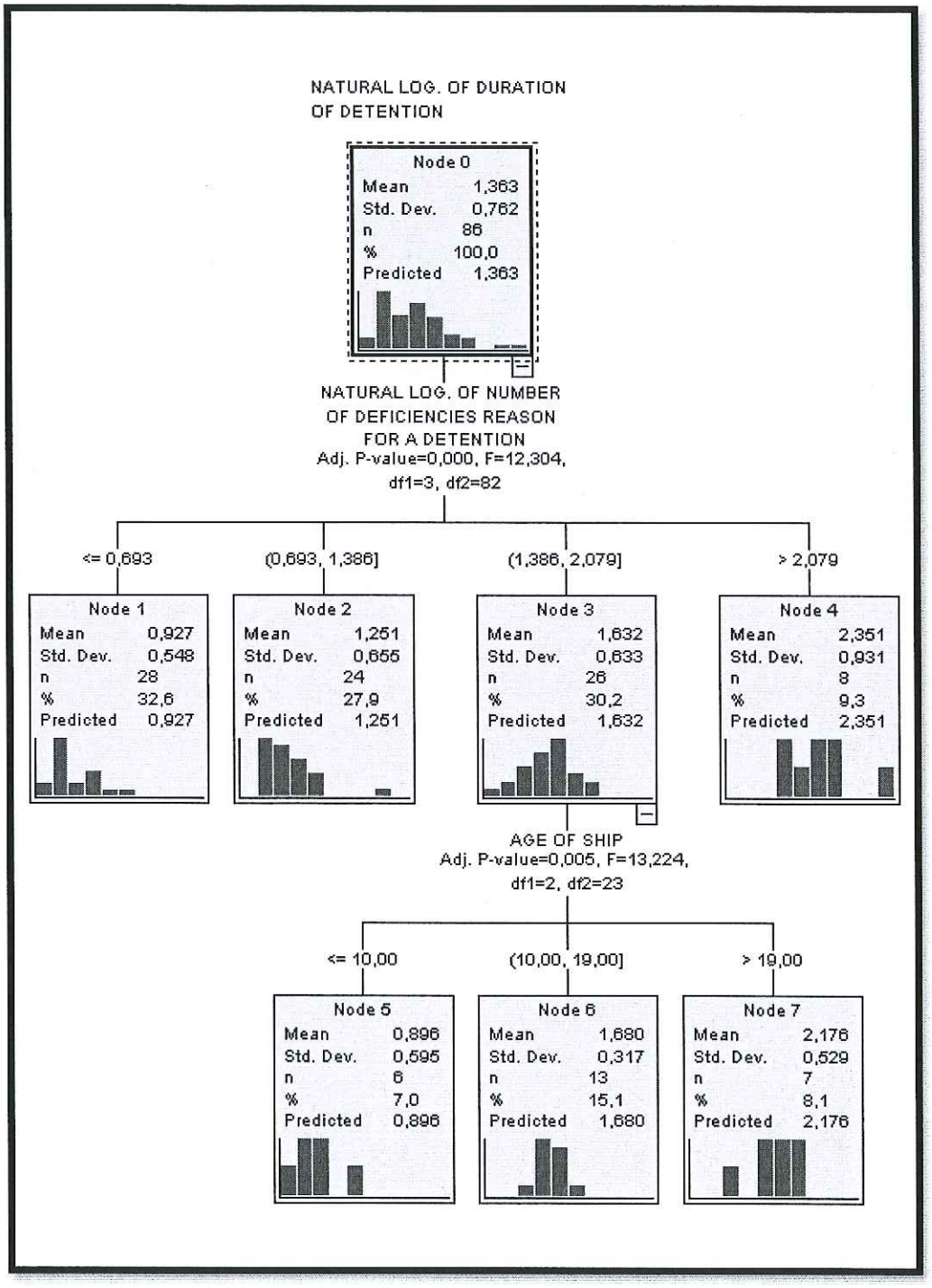

Figure 3.22 Exhaustive CHAID Tree for Container

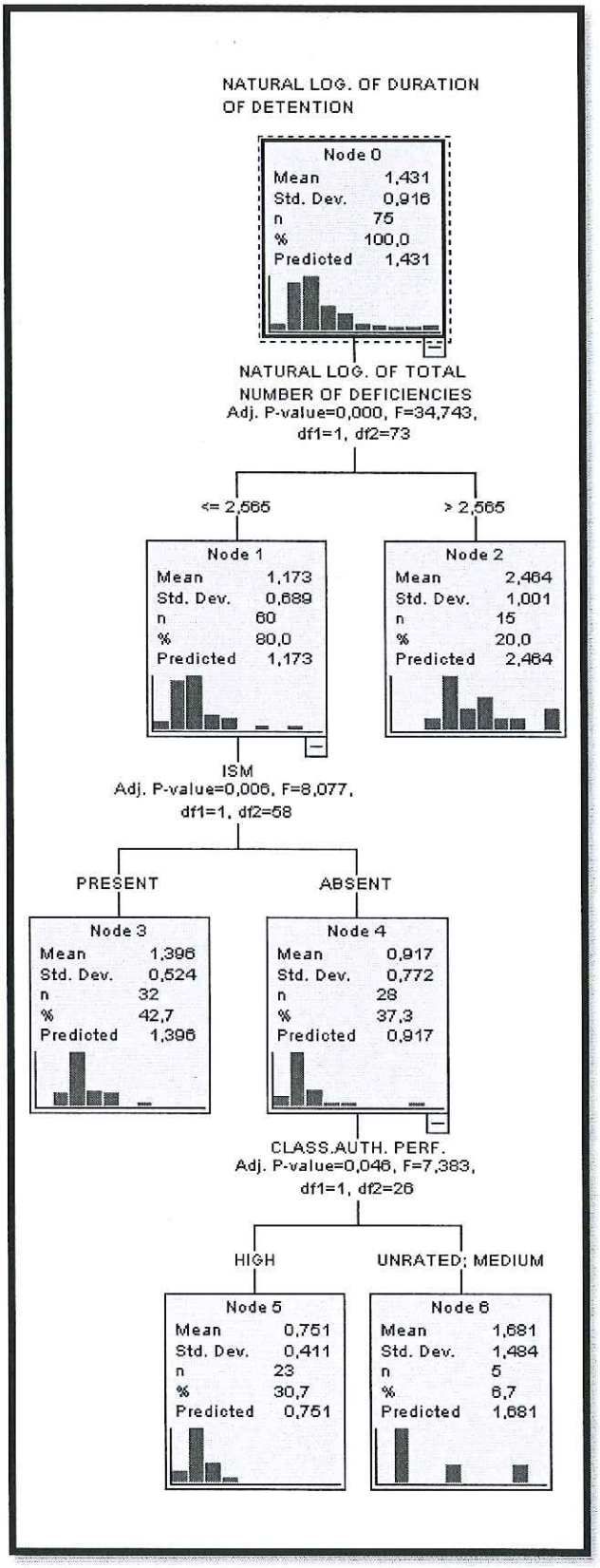

Figure 3.23 Exhaustive CHAID Tree for Chemical Tanker

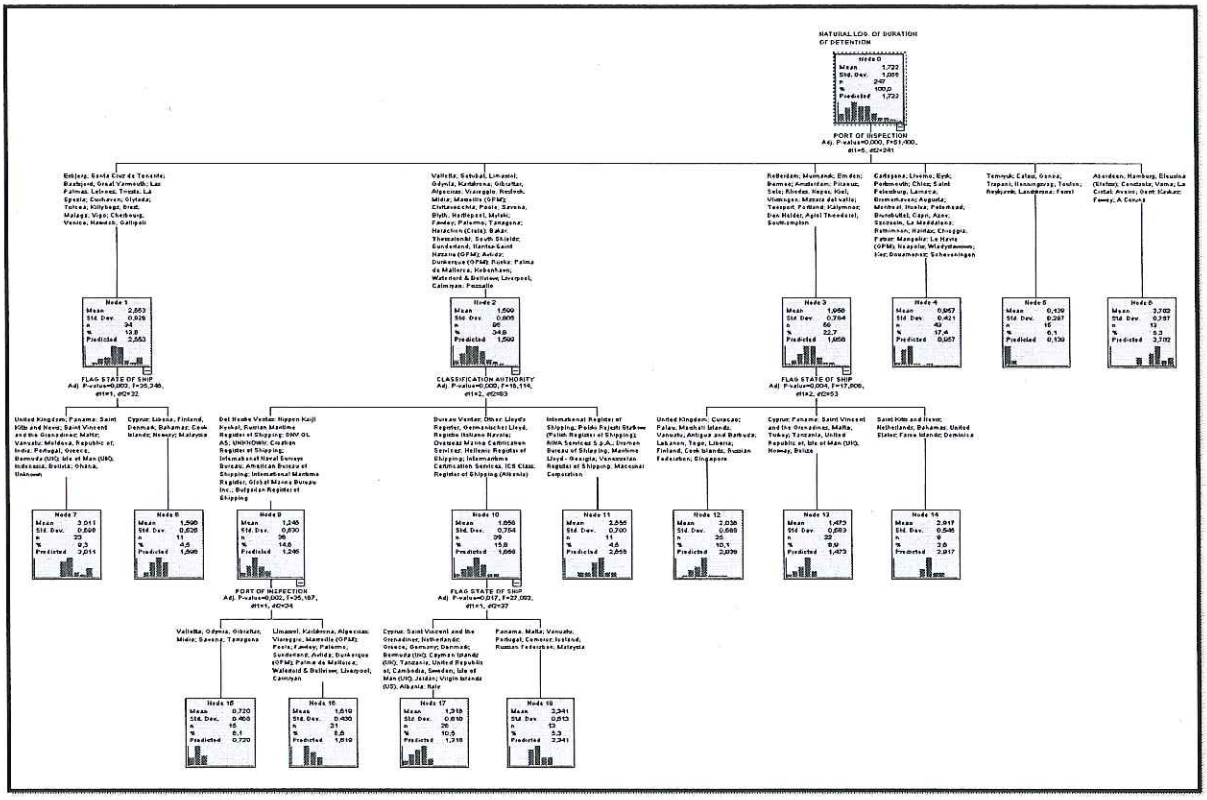

Figure 3.24 Exhaustive CHAID Tree for Other Ship Types

Exhaustive CHAID Tree tries to explain the reasons which cause variance in dependent variable selected. Duration of time actually depends on so many parameters such as reasons for detention, severity of reasons, ability of ship owner/crew to fix the deficiency which is reason(s) for detention, ship's individual special status and some other stochastic parameters which cannot be observed.

In this research main purpose is to find out what make significant change in "duration of detention" statistically. The primary concern of CHAID is to detect important interactions not for improving prediction, but just to gain better knowledge about how the outcome variable is linked to the explanatory factors (Ritchard,2010). Table 3.13 provides the "Risk Outputs" of analyses and a comparison with respect to root nodes. In comparison it can be said 56% of total variance in **Natural Logarithm** of "Duration of Detention" is explained with respectively small standard error. Standard error of "Duration of Detention" (in days) would be **1,065** ($e^{0,063}$).

		Risk		Root Node		Comparison	
	Number of Cases	Estimate (Variance)	Std. Error	Std. Deviation	Variance	Unexplained Variance	Explained Variance
	N	σ^2		σ	σ^2	%	%
General Cargo	912	,332	,021	,884	,781	42,43	57,57
Bulk	362	,348	,032	,798	,637	54,59	45,41
Container	86	,334	,079	,762	,581	57,49	42,51
Chemical Tanker	75	,467	,112	,916	,839	55,70	44,30
Ro-Ro	87	,484	,115	1,016	1,032	46,85	53,15
Oil Tanker	60	,286	,052	1,106	1,223	23,34	76,66
Others	247	,297	,032	1,056	1,115	26,65	73,35
Total	1829						
Mean		,364	**,063**	,934	,887	43,866	**56,134**

Table 3.13 Comparison of Risk Outputs with Respect to Root Nodes

To compare prediction results with respect to observed values, scatter dot plot charts are presented in Figures 3.25 to 3.31. On comparison charts, it can be said that some extreme values cause distortion in charts. Even though these extreme values reduce the prediction accuracy of the model, removing these cases from analysis would be a manipulation to data set. It is a fact that there are many other factors which seriously affect "Duration of Detention" which are not observable. Removing these cases from analysis would result ignorance of this important fact.

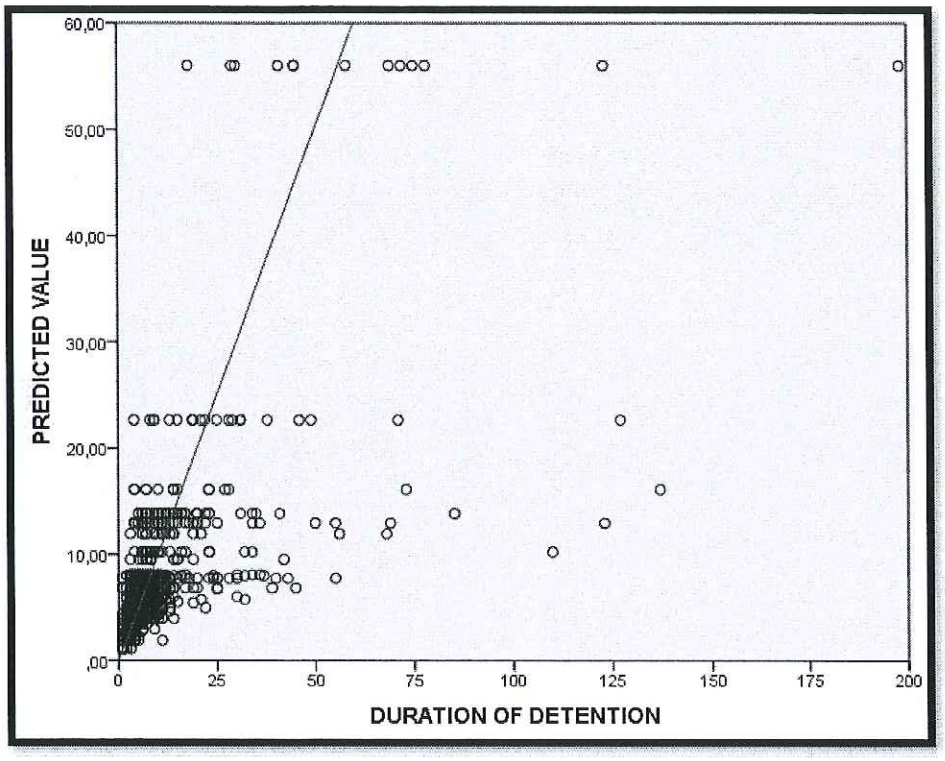

Figure 3.25 General Cargo Predicted vs Observed Values

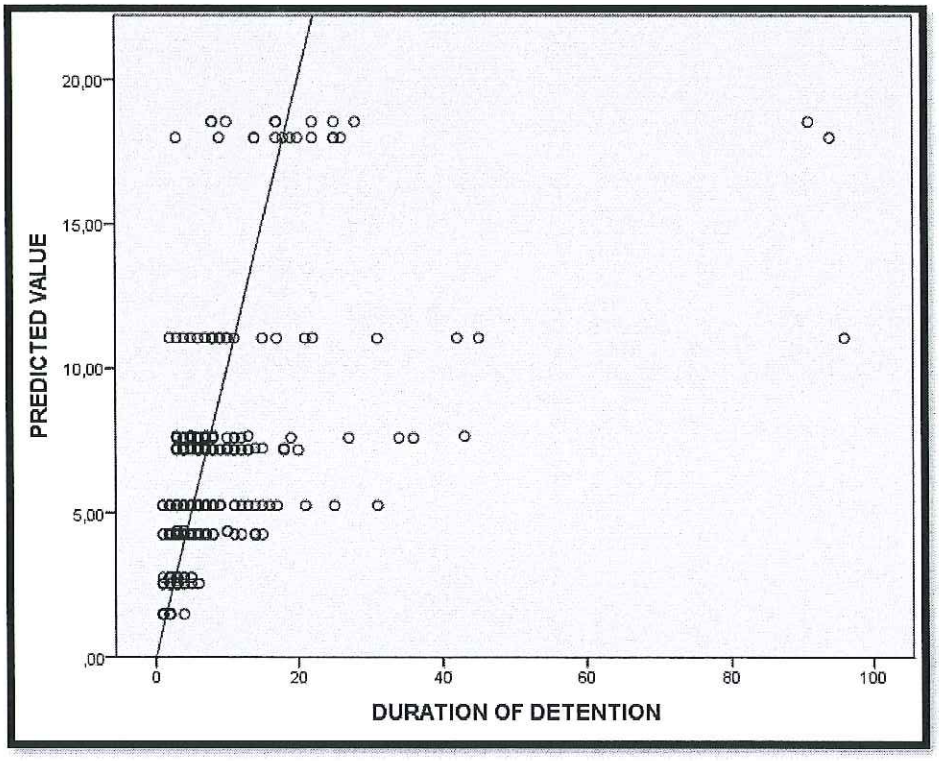

Figure 3.26 Bulk Predicted vs Observed Values

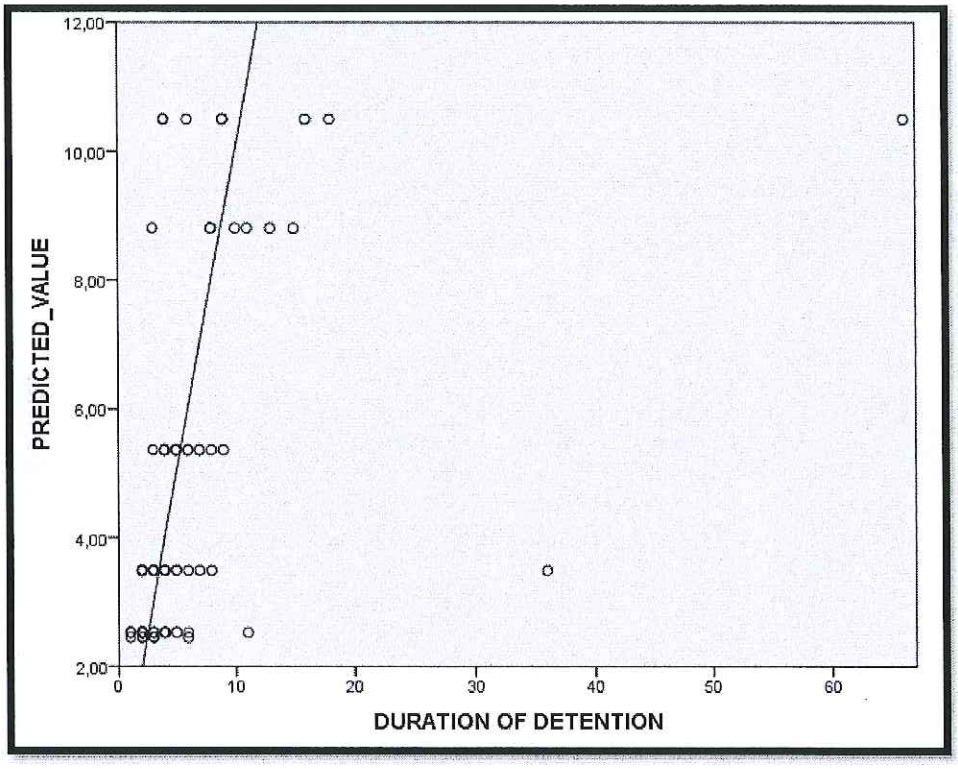

Figure 3.27 Container Predicted vs Observed Values

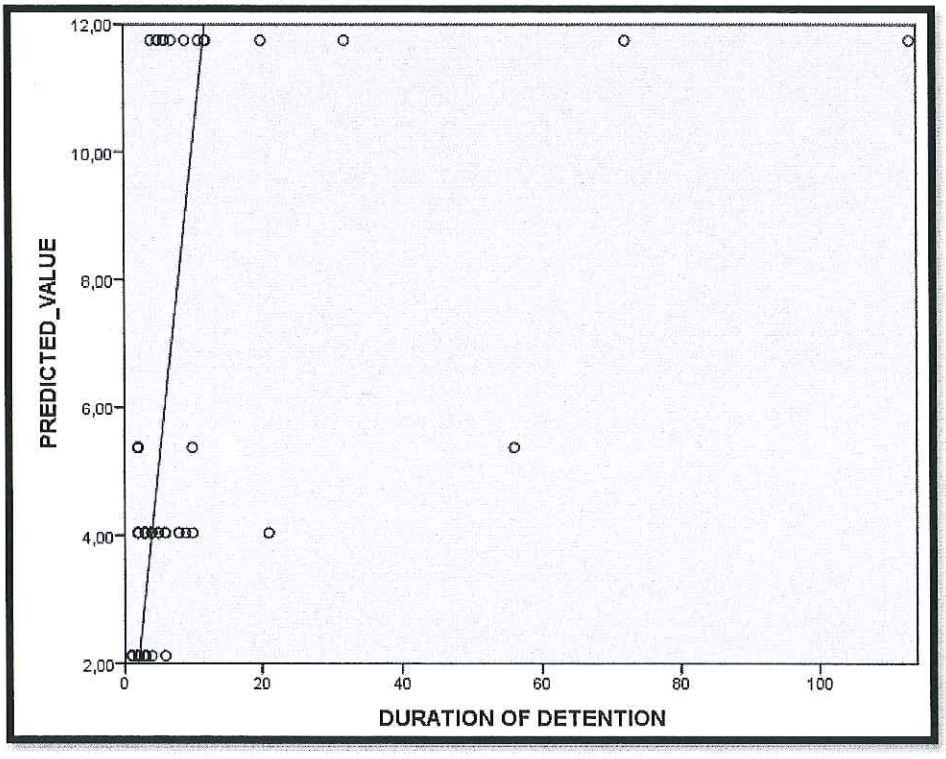

Figure 3.28 Chemical Tanker Predicted vs Observed Values

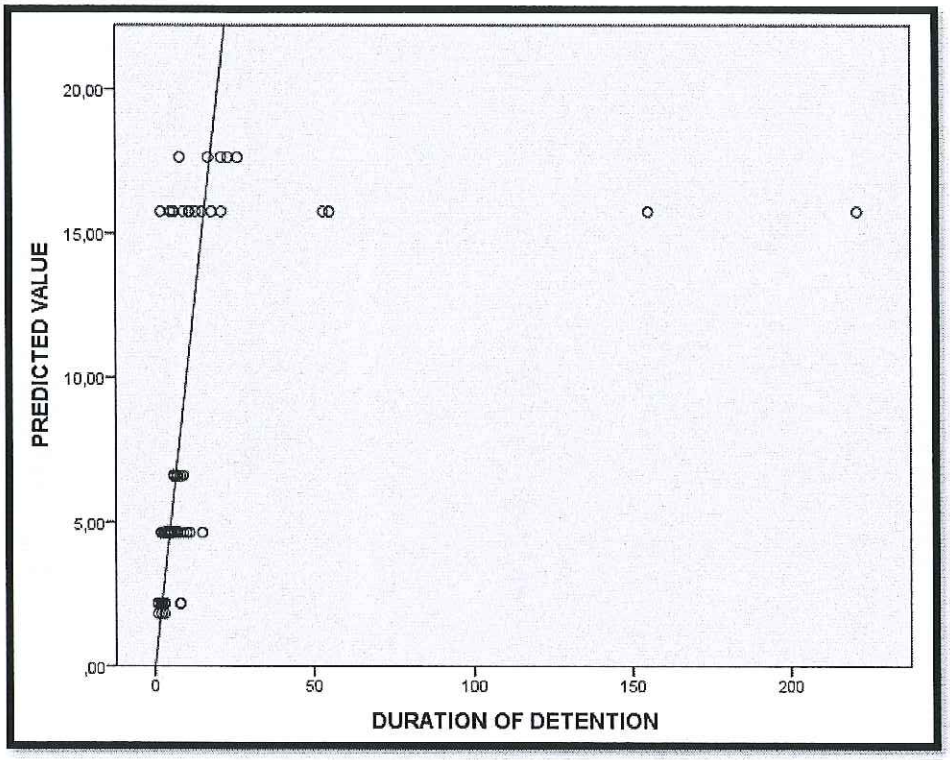

Figure 3.29 Ro-Ro Ships Predicted vs Observed Values

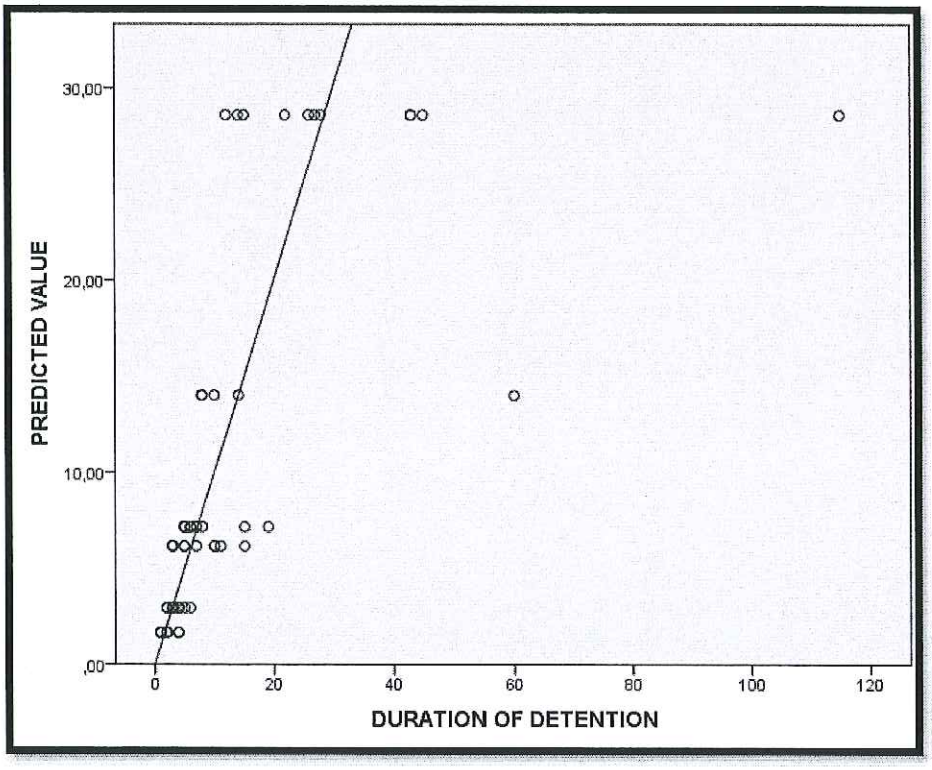

Figure 3.30 Oil Tanker Predicted vs Observed Values

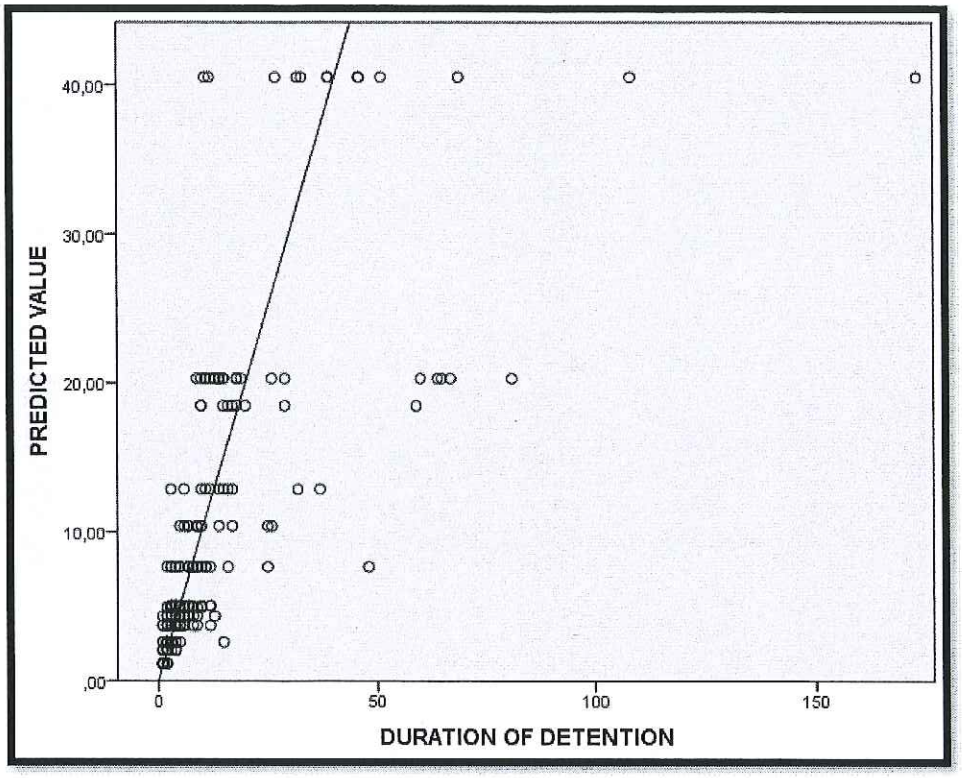

Figure 3.31 Other Ship Types Predicted vs Observed Values

CONCLUSION

Port State Control is one of the most effective ways of Law Enforcement in Maritime Transportation. Main purpose of PSC is increasing Maritime Safety by eliminating sub-standard ships. International Law (UNCLOS 1982) gives the main responsibility to Flag States for ensuring the safety standards of ships which fly their flag. Because of inability or unwillingness of open registry flags, PSC plays more important role as PSC is the most effective alternative of Flag State Control.

Detention is the main instrument of Port State for law enforcement. Detention of a ship no doubt has negative impact to ship owner/manager and additionally other stakeholders of subjected ship. From economic aspect, detention of a ship causes loss of money, time and reputation. Amount of these losses are directly related with the "duration of detention". Obviously best way of preventing a business from these losses is to keep the ship on international standards. To manage detention risk of a ship, parameters which affect "duration of detention" should be known.

In this research, it is tried to find answer for this question: "Which parameters affect the duration of a detention". In addition to Paris MoU detention data, Equasis database (owner/managing state) is used for analysed data set. Exhaustive CHAID algorithm is used for analysis. This algorithm provides high level of flexibility for working with high number of variables where some variables are categorical and some are continuous. CHAID is an iterative analysis where in each step it uses only one independent variable. By this way collinearity of independent variables doesn't distort CHAID algorithm. On the other hand, it should be noted that prediction accuracy of CHAID algorithm is comparatively lower than other predictive models.

Basic statistics showed that almost 60 percent of all detention occasions consist of the ships that are managed by 6 specific countries. These countries are Turkey, Greece, Germany, Ukraine, Russian Federation and Lebanon. Considering the fleet sizes of these countries number of detentions of Turkey, Ukraine and Lebanon managed ships are unexplainable.

Deficiencies are clustered in 6 main titles which consist more than 60 percent of all deficiencies which are reason for a detention. These titles are Fire Safety,

Documentation & Certification, Emergency Systems, Life Saving Appliances, Safety of Navigation and International Safety Management (ISM) Code requirements. Turkish owned/managed ships have similar results where these 6 titles constitute slightly less than 60 percent. Additionally, Turkish owned ships have significantly more deficiencies under "Working Conditions", "Accommodation, recreational facilities, food and catering" and "Conditions of Employment" titles.

The dataset analysed with Exhaustive CHAID algorithm by means of 6 main ship types and rest of the ships from other types. This produced 7 decision trees which provide better understanding for the parameters that affect "Duration of Detention" for each subset of dataset. Exhaustive CHAID algorithm also produced prediction estimates for "Duration of Detention" for each observation. At the end of this work there are comparison charts where "Predicted Values" and "Observed Values". It can be said that prediction accuracy is higher where durations are less than 10 days.

Results of the analyses showed which factors generate variance in Duration of Detention. In 6 of 7 subset of data set, Duration of Detention vary significantly by Port of Inspection. Although 6 owner/managing countries dominates the detention lists, Duration of Detention doesn't vary by owner/managing countries. 7 decision trees finally explained 57 % of total variance. This result reminds that there are some other factors which affect "duration of detention" that are not included into analyses. As it is discussed in research section, many unobservable factors may affect duration of detention.

Further researches on this subject may be conducted in Tokyo MoU data set and/or sum of Paris and Tokyo MoU data sets. Comparison of different regional control regimes may give better understanding about subject.

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