THE ASSESSMENT OF MARITIME SAFETY IN THE TURKISH STRAITS BASED ON THE PERFORMANCE OF FLAG STATES IN PORT STATE CONTROL REGIMES

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SUMMARY

The Turkish Straits are well known for theirs intensive maritime traffic. The average annual number of transit ships passing through this waterway is approximately 50000 and more than 100 flag states pass through it. Moreover, this waterway presents a navigational challenge owing to its inherent geographic and oceanographic characteristics. Also, sub-standard ships navigating in this region lead to an increased risk levels and pose a threat to the marine environment. Over the years, serious maritime accidents occurring in the straits region had resulted in losses of life and constituted environmental disasters. The high risk arising from maritime shipping in these regions had always endangered public health in the vicinity of the Turkish Straits. In this study, maritime safety in the Turkish Straits region had been assessed based on the performance in the Port State Control inspections of flag states passing through this region. For the assessment of the performance of passing flag states, detention and deficiency indices of these flag states were generated for the MOUs. According to these values, the risk level of these flag states had been determined by the weighted risk point methods. Hereby, in addition to the determination of the risk level of flag states, the relationships between the inspections of MOUs had been also discussed on the basis of both the detention and the deficiency rates of flag states.

1. INTRODUCTION

The Turkish Straits, which comprise the Istanbul Strait, the Çanakkale Strait and the Marmara Sea, are important from a strategic and geographic points of consideration. For centuries, this waterway has become an important link due to the fact that Black sea countries are connected to the open seas through this water way. It is one of the waterways having the heaviest transit maritime traffic in the world (www.denizticaretodasi.org.tr). The average annual number of ships passing through this region is approximately 50000 and more than 100 flag states pass through this region (www.aakkm.udhb.gov.tr). Moreover this waterway is dangerous for navigation owing to its narrow and sharp turns requiring that ships alter their course at least 12 times along its course as well as the presence of powerful currents that reach relative speeds of 4-5 knots, in some sections (www.denizticaretodasi.org.tr; Köse, *et al.*, 2003). In the same time, the most populated cities such as Istanbul are located along its surrounding shores. This region is known for its intensive urban maritime traffic. This urban maritime traffic contributes to navigational dangers, as well. In addition to these prevalent dangers, severe weather conditions significantly affect the maritime traffic in this region and create a risk. About 18% of all maritime accidents in the straits' region have occurred due to severe weather conditions (Kara & Emecen Kara, 2016). Due to all these characteristics of the Turkish Straits, this region has potentially high risk for maritime accidents. Over the years, there have been several maritime accidents, such as, grounding, contact, collision, and fire with harmful impact on both the marine life and environment in the Straits region (Emecen Kara, 2016). In addition to these risks, exhaust emission from ships contributes to air pollution in cities around the Turkish Straits (Emecen Kara, 2006; Emecen Kara, *et al.*, 2004; Doğrul, *et al*, 2016).

Sub-standard ships, navigating in this region, do certainly lead to an increase in the risks that exist due to the characteristics of these Straits, and so threaten maritime safety in this region, as well. Some studies that evaluate the performances of Port State Control (PSC) regimes reported that there is a higher number of sub-standard ships in some regions such as the Black Sea Region (Piniella, *et al.*, 2014; Bang & Jang, 2012). Also, it has been pointed out that the likelihood of an increase in the number of sub-standard ships in these regions due to variations in PSC regimes (Bang, 2008).

The sea worthiness of a ship is one of the most important factors for the provision maritime safety. Maritime safety implies that the risks arising from maritime shipping have been minimized enough. Various regulations were introduced by International Maritime Organization (IMO) to decrease the risks arising from maritime transportation in the world seas and to provide protection of the marine environment and life (Emecen Kara, 2016). These maritime safety regulations include standards for ship safety, combating pollution, cargo handling, and crew competency. It is the primary responsibility of flag states to enforce that all ships on their registers comply with these international maritime safety standards. Classification societies are also responsible for performing periodic safety survey of ships. PSC mechanisms play an important role in ensuring maritime safety in the world seas. Foreign flag ships are inspected by port states in accord with international regulations, when visiting their sea ports. A ship that does not meet international regulations is called as sub-standard ship. This implies that the ship has major safety deficiencies and it is unseaworthy.

To develop a sustainable and effective PSC mechanism, maritime safety regimes have been established (Emecen Kara, 2016). Currently, nine regional agreements on PSC (Memorandum of Understanding on PSC – MOU) exist. These MOUs are respectively, the Paris MOU (Europe and the North Atlantic region), the Viña del Mar Agreement (Latin American region), the Tokyo MOU (Asia-Pacific region), the Caribbean MOU (Caribbean region), the Mediterranean MOU (Mediterranean region), the Indian Ocean MOU (Indian Ocean region), the Abuja MOU (West and Central African region), the Black Sea MOU (Black Sea region), and the Riyadh MOU (the Gulf Region). Additionally, the United States Coast Guard (USCG) carries out PSC inspections over its coasts (Emecen Kara, 2016; Emecen Kara & Okşaş, 2015). All regional MOUs aim to eliminate sub-standard ships and enhance maritime safety in their regions. Although all the regional MOUs are the same in the theory, there are differences among them in certain issues such as the evaluation of performance, the selection of priority ships for inspection, and the level of strictness and uniformity of inspections (Emecen Kara, 2016; Emecen Kara & Okşaş, 2015; Emecen Kara & Okşaş, 2016; Knapp & Van de Velden, 2009; Knapp & Franses, 2007). As would be expected, this is owing to geographic, cultural and historical factors. The average detention and deficiency rates vary across various regional MOUs depending on these factors. While some PSC regimes employ a custom-made target factor in order to decide whether to inspect a certain ship, the Paris and Tokyo MOUs as well as USCG use a quantitative system based on risk assessment (Knapp & Franses, 2007). In the Paris MOU and the Tokyo MOU, the ship's risk profile is determined by the ship's generic parameters and historic parameters. Flag state performance is one of the ship's generic parameters with heavily weighted. For the assessment of flag state performance, the Black/Grey/White (BGW) lists are generated based on the statistics of inspection and detentions conducted during the previous 3 years. Accordingly, black listed flag states are assessed as high risk (www. parismou.org & www. tokyo-mou.org). Similarly, the USCG applies a targeting matrix serves in assigning the priority of ship inspection. Flag state performance is used as the major risk factor in this targeting matrix. The performance of flag state is evaluated according to detention rate calculated based on inspection data of the past three years. If detention rate of a certain flag state is exceeds the over-all average for all flag states, this flag state is considered risky (www.uscg.mil).

A number of academic studies have been carried out so far in order to determine the effect of PSC on maritime safety. Some of these studies focus on the relationship between casualties and PSC inspections taking into consideration various parameters: such as, ship type, ship age, flag state, and open registers (Li & Wonham, 1999; Li, 1999; Alderton & Winchester, 2002; Knapp & Franses, 2007; Li & Zheng, 2008); Degre, 2008; Knapp & Franses, 2008). The results of, thus obtained, indicated the existence of a high correlation between the total loss rate and the detention rate, as well as the existence of a decline in the total loss rate due to PSC. One of the results is that inspections have a strong effect in decreasing the probability of casualty in certain regions. Other studies taking into consideration the deficiencies detected in inspections reached the conclusion that a reduction in deficiencies has been realized between earlier and subsequent inspections (Heij, Bijwaard & Knapp, 2011; Piniella, Rasero & Aragones, 2005; Cariou, Mejia & Wolf, 2007, 2008; Mejia, Cariou & Wolf, 2010). One of the results drawn in these studies is that the deficiencies are strongly dependent on the vessel's age, the flag of registry, and the type of ship.

In addition to these studies, a number of studies, have been carried out, that focus on differences in the implementation of PSC and the evaluation of MOUs' performance. Emecen Kara and Okşaş analysed and reported all MOUs performances through comparisons of: the detention and deficiency rates, type of deficiencies, detained ship types, flag states and recognized organizations (Emecen Kara & Okşaş, 2016). They concluded that the largest number of inspections were made in both the Paris MOU and the Tokyo MOU. Knapp and van de Velden aimed at the visualization of differences in the treatment of vessels across PSC regimes, according to deficiency codes and ownership groups (Knapp & Van De Velden, 2009). They concluded that some MOU regimes are characterized by certain deficiency categories. One of the conclusions reached in this study is that a uniform interpretation of the requirements of the international conventions doesn't yet appear to exist. Knapp and Franses examined possible differences across PSC regimes based on the detention probability according to ship types and deficiencies categories (Knapp & Franses, 2007). They concluded that most differences, existing across different regimes, could be attributed to deficiencies towards detention and the port state in consideration. Piniella et al. compared the Paris MOU, the Tokyo MOU and the Viña Del Mar agreement for analysis of the number of vessels detained (Piniella, Rodriguez-Diaz & Alcaide, 2014). They concluded that the Paris MOU and the Tokyo MOU exhibited similar trends, whereas the Viña del Mar agreement lagged behind in comparison with the standards of both the Paris and Tokyo MOUs. Li and Zheng aimed at the investigation of the effectiveness of the ship selection method for the inspection; they found that the Paris MOU and the Tokyo MOU had the most efficient ship selection method (Li & Zheng, 2008). Payoyo examined the implementation of international conventions across PSC regimes and came to the conclusion that the Paris MOU regime has been quite successful in the reduction of sub-standard ships (Payoyo, 1994). Also, Cariou *et. al* examined the determinants of the number of deficiencies and the detention probability using the Indian Ocean MOU inspection data (Cariou, Mejia & Wolf, 2009). One of the findings of this study is that the inspecting authority is one of the important factors governing differences in the observed detention rates. They also stated that most of this differences stem from differences in the characteristics of vessels' calling. Bang and Jang discussed the regional PSC regimes for purposes of comparison between them and to evaluate which MOUs are needy of more support (Bang & Jang, 2012). They labelled both the Paris MOU and the Tokyo MOU as the most successful regional MOUs. They emphasized the importance of the reducing disparity between regional MOUs in the process of elimination of sub-standard ships. Also, they reported on the likelihood of an increase in the number of sub-standard ships in the Abuja and Black Sea MOUs regions. Bang screened the effectiveness of PSC in combating vessel-source pollution prevention, employing an empirical survey of trends in practice (Bang, 2008). One of the findings of this study is that the number of deficiencies and detentions in both the Paris and Tokyo MOUs has been decreasing; whereas the other MOUs, such trends have not been observed, except for a decrease in the number of detentions in the Indian Ocean MOU within the duration of their study. Moreover, they reported that the increases in the number of deficiencies in the Viña del Mar Agreement, the Black Sea and Indian Ocean MOUs might indicate an increase in the number of sub-standard ships in these regions. Emecen Kara, as part of her study, investigated the performance of flag states in the Black Sea MOU over time generating the BGW List of Black Sea MOU (Emecen Kara, 2016). The results indicated that the Black Sea MOU has been effective in decreasing the risk level in the Black Sea Region.

The common findings of all these studies are that there are differences among regional MOUs, and that the Paris and the Tokyo MOUs are both experienced and effective in comparison to other MOUs. Despite the fact that there is disparity between regional MOUs, nonetheless it is supposed that PSC mechanism is one of the most important ways to ensure maritime safety at seas as well as the protection of the marine environment in these studies. In this context, the risks arising from maritime shipping cannot be eliminated due to the aforementioned characteristics of the Turkish Straits, nonetheless they might be reduced through PSC inspections (Emecen Kara, 2016; Emecen Kara & Okşaş, 2015). In the same time, these inspections are an important indicator for maritime safety in this region because they demonstrate the risk level of passing ships (Emecen Kara, 2016; Emecen Kara & Okşaş, 2015). In the most successful PSC regimes such as the Paris and Tokyo MOUs and the USCG, flag state performance is accepted as an important risk factor in the determination of the risk level of a ship. Flag states have a principle responsibility in ensuring that ships flying their flags comply with the international maritime safety standards. In this context, maritime safety in the straits is closely related to the performance of passing flag states in PSC inspections, because these performances reflect their level of deficiencies as related to maritime safety standards.

Several studies have been concerned with assessing maritime safety in the Turkish Straits. Almost all of these studies focused attention on maritime safety in the Istanbul Strait and most of them didn't take into account the performance of ships on the PSC inspections. In these studies concerning the Istanbul Strait, various parameters have been employed; such as, traffic flow, urban traffic volume, and the probability of collision (Or & Kahraman, 2002; Arslan & Turan, 2009; Uluscu *at al.*, 2009); Or, Sevilir & Erkut, 1999; Görçün & Burak, 2015). They have reported findings as regards the most risky areas, factors causing shipping accidents, possible factors contributing to accidents, and the impact of various factors affecting the risk levels. Only, in one study the risks arising from maritime transportation in the Istanbul Strait are determined based on the performances of flag states on the Black Sea MOU (Emecen Kara, 2016). In another report, maritime safety in the Istanbul Strait had been evaluated using parameters of average detention and deficiency rates of flag states in the Black Sea MOU as well as other regional MOUs, generally (Emecen Kara & Okşaş, 2015).

This study focuses attention on maritime safety in the Turkish Straits from a different perspective. Safety is evaluated on the basis of the performances in the PSC inspections of flag states passing through this region. The detention and deficiency indices of flag states in the MOUs are calculated for assessment of their performances. In the determination the performance of flag states, the inspection performance of MOUs, comparing with that of Paris MOU, has been taken into consideration, as well. According to these calculated values, the risk levels of passing flag states are determined on basis of the weighted risk point method, as discussed below. Accordingly, in addition to the determination of the risk level of flag states passing through this region, the relationships between the inspections of MOUs are also discussed based on both the detention and the deficiency rates of flag states.

2. METERIAL AND METHOD

2.1 METHOD TO DETERMINATION OF THE RISK LEVEL OF FLAG STATE

The risk level of each flag states passing through the Turkish Straits is determined depending on its Weighted Risk Point *WRP* that is calculated by the following equation:

$$WRP = q_i \; IPP \tag{1}$$

In the equation; $i.$ refers to a certain flag state, q_i is weighted passing rate of a flag state and IPP is the performance point based on PSC inspections of a flag state. The value of q_i is determined in accord with its passing rate. Passing Rate is defined as the ratio of the total passing number of ships of a certain flag state to the total number of passing ships over three years (Emecen Kara, 2016).

IPP is calculated based on both the detention and the deficiency rates according to the following equation, in a similar manner to evaluation of flag state performance in the Paris and Tokyo MOUs and the USGC.

$$IPP = \sum_{j=1}^{n} a_j \, Pd_{ij} + \sum_{j=1}^{n} b_j \, Pt_{ij} \qquad (2)$$

where;
a_j is the weighted point of detention in the *j-th* MOU,
Pd_{ij} is the detention index level point in the *j-th* MOU of *i-th* flag state,
b_j is the weighted point of deficiency in the *j-th* MOU,
Pt_{ij} is the deficiency index level point in the *j-th* MOU of *i-th* flag state,
m is the total number of flag states, $i = 1,2, \dots \dots \dots m$
n is the total number of MOUs, $j = 1,2, \dots \dots \dots n$

Detention index level point Pd_{ij} and deficiency index level point Pt_{ij} are determined according to detention index value and deficiency index value of a flag state. Detention index d_{ij} is calculated by comparing detention rate of a flag state with regional detention rate as shown equation (3). Detention rate of a flag states is determined that it's the total number of detentions divided by it's the total number of inspections over three consecutive years.

$$d_{ij} = \frac{Detention\ rate\ of\ the\ i-th\ Flag\ state\ in\ the\ j-th\ MOU}{Regional\ detention\ rate\ in\ the\ \ j-th\ \ MOU} \qquad (3)$$

Deficiency index $\boldsymbol{t_{ij}}$ is calculated using equation (4) in a similar manner to the detention index d_{ij}. Deficiency rate of a flag state is the ratio of the total number of inspections with deficiencies to the total number of inspections over three years (Emecen Kara, 2016).

$$t_{ij} = \frac{Deficiency\ rate\ of\ the\ i-th\ Flag\ state\ in\ the\ j-th\ MOU}{Regional\ \ deficiency\ rate\ in\ the\ \ j-th\ \ MOU} \qquad (4)$$

The inspection performance of each MOUs has been evaluated in comparison to the Paris MOU. Therefore, the weighted points depending on the port state performance in comparison to the Paris MOU for a certain MOU (a_j , b_j) are determined employing the cluster analysis. The correlation matrix of detention rates and the correlation matrix of the deficiency rates are used for achieving this end.

The risk levels and their corresponding weighting points on basis of the detention and deficiency index values, correlation of each MOUs with the Paris MOU and passing rates are listed Table 1.

Table 1. Risk levels and weighted points.

Detention Index (d_{ij})	Risk Level	Weighted P. (Pd_{ij})
(d_{ij}) < 1	Low Risk	0
1 ≤ (d_{ij}) < 2	High Risk	1
(d_{ij}) ≥ 2	Very High Risk	2
Deficiency Index (t_{ij})	Risk Level	Weighted P. (Pt_{ij})
t_{ij} < 1	Low Risk	0
1 ≤ t_{ij}< 2	High Risk	1
t_{ij}≥ 2	Very High Risk	2
Correlation Value	Level of Relationship	Weighted P. (a_j, b_j)
Correlation < 0.35	Low and Very Low	0.25
0.35 ≤ Correlation < 0.70	Medium	0.50
Correlation ≥ 0.70	High and Very high	1
Passing Rate (%)	Level of Passing	Weighted P. (q_i)
Passing Rate < 5	Low	0.25
5 ≤ Passing Rate < 15	Moderate	0.50
Passing Rate ≥ 15	High	1

2.2 METHOD FOR CATEGORIZATION OF VALUES OF *IPP* AND *WRP*

IPP and WRP values calculated are categorized into risk levels using the following method;

$$\Delta p = \frac{Pmax - Pmin}{N} \qquad (5)$$

Where, $Pmax$ is the largest value in the series, $Pmin$ is the smallest value in the series, N refers to the total of risk levels. Each risk level is determined by; $Pmin + \Delta p$, $Pmin + 2\Delta p$, $Pmin + 3\Delta p$, $\dots Pmin + n\Delta p$. Thus, flag states are divided into the following risk level;

$$Pmin \leq Level\ 1 < Pmin + \Delta p$$
$$Pmin + \Delta p \leq Level\ 2 < Pmin + 2\Delta p \qquad (6)$$
$$\vdots$$
$$Pmin + (n-1)p \leq Level\ n < Pmin + n\Delta p$$

3. RESULTS

3.1 FLAG STATES PASSING THROUGH THE TURKISH STRAITS

The total number of ships passing through the Istanbul Strait is 135,605 for the period 2013-2015, this value is 130,701 in the Çanakkale Strait (www.aakkm.udhb.gov.tr). Around 120 flag states passed through the Turkish Straits during this period. The passing percentage of flag states that have 0.5 % or more passing percentage are shown in Figure 1 for this period. The six ranking flags states with higher passing percentage are Turkey, Malta, Panama, Russia, Liberia and Marshall Islands.

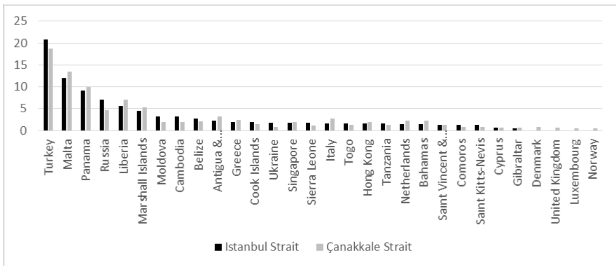

Figure 1. Passing percentage of group I flag states for the period 2013-2015.

3.2 THE RELATIONSHIPS AMONG THE MOUs AND THE WEIGHTED POINTS OF MOUs

Two correlation matrices for the MOUs with their elements the detention rates and the second with the deficiency rates of flag states on the MOUs were generated in order to specify relationships between MOUs and to determine values of the weighted points, for each MOUs. The data used to calculation of detention and deficiency rates was obtained from the annual reports of MOUs for the period 2013-2015 (www.parismou.org; www.tokyomou.org; www. caribbeanmou.org; www.bsmou.org/about; www. acuerdolatino.int.ar; www.abujamou.org; www. riyadhmou.org; www.iomou.org; www.medmou.org; www.uscg.mil). According to the correlation matrix based on detention rates of flag states, the Paris MOU and the Tokyo MOU have the strongest correlation with 0.74. It is seen that the Abuja MOU has a very low to low correlations with other MOUs. According to the deficiency rates correlation matrix, the Paris and Mediterranean MOUs have a correlation of 0.87 with the Paris and Tokyo MOUs second with 0.85 correlation. Once again, it is apparent that the Abuja MOU is lowest in deficiency rate's correlation with other MOUs.

Dendrograms based on detention rates and deficiency rates are represented in Figures 2 and 3. The detention rates-clustering elucidates a strong relationship between the Paris MOU and the Tokyo MOU as well as the USGC. Another cluster comprises the Riyadh MOU, sub-clusters of Black Sea MOU and the Caribbean MOU encompassing the Viña del Mar agreement, and a sub-cluster of the Mediterranean MOU and the Indian Ocean MOU. This cluster is similar to cluster of the Paris MOU, the Tokyo MOU, and the USGC with a correlation of 0.36. Again the Abuja MOU is the least similar to these clusters with a correlation of 0.17.

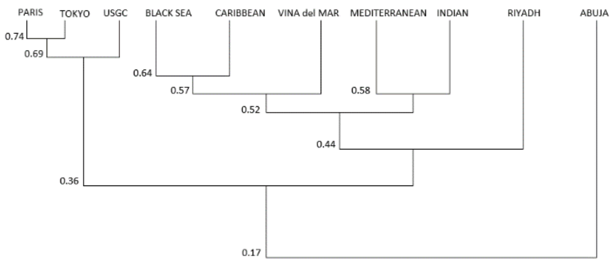

Figure 2. Dendrogram of detention rates.

On the other hand the deficiency rates-clustering, is a bit different from the detention rates dendrogram, shows a sort of gradual correlation between the MOUs. The Paris MOU, the Mediterranean MOU, and the Tokyo MOU, and the Indian Ocean MOU have a very high correlation (higher than 0.8). The Abuja MOU comes last with a correlation 0.39.

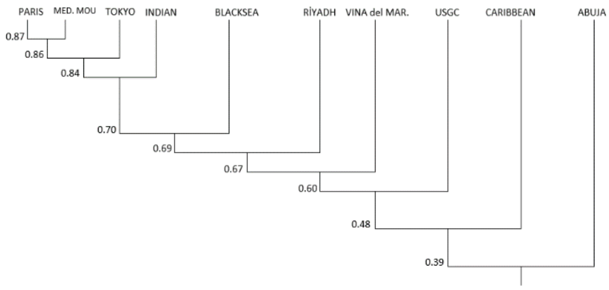

Figure 3. Dendrogram of deficiency rates.

The weighted points of MOUs is assigned taking into consideration the results of these cluster analyses. The Paris MOU has been taken as the benchmark for the assignment of such weighted points of the MOUs. In this context, according to the clustering of detention rates given in Figure 2 and values of correlation given in Table 1, the Paris MOU, the Tokyo MOUs and the USGC are weighted with 1 point. The Indian Ocean MOU, the Viña del Mar Agreement, the Caribbean MOU and the Riyadh MOU are weighted with 0.5 point. Also, the Black Sea MOU and the Mediterranean MOU that are elements of the same cluster with these MOUs are weighted with 1 point, because flag states passing through the Turkish Straits region are inspected in their seaports. The Abuja MOU is weighted with 0.25 point.

Similarly, the weighted points for deficiency rates are assigned according to Figure 3 and Table 1. The Paris MOU, the Mediterranean MOU, the Tokyo MOU, the Indian Ocean MOU and the Black Sea MOU are weighted with 1 point, the others are weighted with 0.5 point.

In addition to these matrixes, the correlation between detention rates and deficiency rates of each MOUs has been calculated. According to this calculation, it is found that the Paris MOU have highest correlation value with 0.79. The corresponding values are 0.64 for the Indian MOU and 0.69 for the Abuja MOU. The USGC and the Caribbean MOUs have the lowest values with 0.30 and 0.44, respectively. Other MOUs have a correlation about 0.55.

3.3 THE PERFORMANCE OF FLAG STATES IN THE MOUs

Detention and deficiency indices are calculated using equations (3) and (4) in order to determine the performance of flag states. Regional detention and deficiency rates in the MOUs, which they are employed to calculate these indices, are summarized in Table 2. It is apparently clear that the regional detention and deficiency rates had been different for within this specific period. It's apparently clear that the regional detention rates are quite small in the Abuja MOU, the Riyadh MOU, and the Viña del Mar Agreement.

Table 2. Regional detention rates and deficiencies rates in the MOUs (2013-2015).

	Paris MOU	Tokyo MOU	Black Sea MOU	Indian Ocean MOU	Mediterranean MOU	Abuja MOU	Caribbean MOU	USCG	Vina Del Mar Agreement	Riyadh MOU
Detention Rate (%)	3.47	4.04	3.65	6.27	5.57	0.41	1.89	1.67	0.96	0.95
Deficiency Rate (%)	55.44	61.36	60.53	55.60	51.45	58.41	40.75	28.77	27.78	22.46

Tables 3 (a) and (b), given in the appendices, show the calculated detention indices of flag states passing through the Turkish Straits for the period 2013-2015. Table 4 (a) and (b), given in the appendices, show the calculated deficiency indices of the flag states passing through the Straits for this period. Some flag states in some MOUs don't have an index value in these tables, because they are not listed in that MOUs for this period.

According to detention indices, it is clearly apparent that Tanzania, Palau and Cambodia have a very high risk level in the all MOUs that they were listed, with a zero value in one MOU. Moldova and Comoros have a very high risk level in the all MOUs that they were listed, with a zero record in two MOUs. Togo and St. Kitts and Nevis have a very high risk level in 7 of the MOUs. Belize and Sierra Leone have a very high risk level in the 6 of MOUs. Tuvalu and Dominica have a very high risk level in the 5 of MOUs. St. Vincent and the Grenadines, Egypt, Kiribati and Bolivia have a very high risk level in 4 of MOUs. It is wort noting here that some flag states such as Marshall Islands, Singapore, Hong Kong, United Kingdoms, Gibraltar, China, Cayman Islands, France, Belgium, and Bermuda have a low risk level in the all MOUs.

According to deficiency indices, Moldova, Cambodia, Ukraine, Sierra Leone, Tanzania, Comoros, Togo, Saint Kitts and Nevis, Palau have a high and very high risk level in the all MOUs that they were listed. Russia, Cook Islands, Tuvalu and Bolivia have a high and very high risk level in the all MOUs, with a single exception of one MOU. Togo and Tanzania are flag states that are seen to have a very high risk level with 4 MOUs. St Vincent and the Grenadines has a high risk level in the all MOUs that it was listed. Belize has a high risk level in the all MOUs that they were listed, except for one MOU. Singapore, Hong Kong, United Kingdom, Norway, Sweden and Cayman islands are found to be having a low risk level in all MOUs. Marshall Islands, Greece, Denmark, China have a low risk level in all MOUs, with a single exception. Some flag states such as Ukraine, Bulgaria, Lebanon, Moldova, Cambodia, Syria, Azerbaijan and Algeria had not been listed in most of MOUs.

3.4 CATEGORIZATION OF VALUES OF *IPP* AND *WRP*

Intervals of *IPP* and *WRP* values corresponding to the risk levels have been determined using equations (5) and (6). According to *IPP* values, flag states are divided into five risk levels; medium to low risk, medium risk, medium to high risk, high risk and very high risk. Flag states having zero value are grouped as low risk level. Risk levels related to *IPP* values are shown in Table 5.

Table 5. Risk levels related to *IPP* values.

IPP	**Risk Level**
$19.3 \leq IPP < 24.0$	Very High Risk (VHR)
$14.6 \leq IPP < 19.3$	High Risk (HR)
$9.9 \leq IPP < 14.6$	Medium to High Risk (M to HR)
$5.2 \leq IPP < 9.9$	Medium Risk (MR)
$0.5 \leq IPP < 5.2$	Medium to Low Risk (M to LR)

According to *WRP* values, flag states are divided into three risk levels; low risk, standard risk and high risk. In the meanwhile, the ship risk profile in the Paris MOU is also determined using these risk levels (Emecen Kara, 2016; www.parismou.org). *WRP* ranges related to risk levels are shown in Table 6.

Table 6. Risk levels related to *WRP* values.

WRP	**Risk Level**
$5.0 \leq WRP < 7.5$	High Risk
$2.5 \leq WRP < 5.0$	Standard Risk
$0 \leq WRP < 2.5$	Low Risk

3.5 PERFORMANCE POINT ON PSC INSPECTIONS OF FLAG STATE

The *IPP* values of flag states calculated using equation (2) are listed in Table 7. According to the *IPP* values, Tanzania, Saint Kitts and Nevis, and Togo, which they are flag states in Group I, have very high risk levels. Sierra Leone, Belize, Comoros, Moldova, Saint Vincent and the Grenadines, Cook Islands and Cambodia have high risk levels. While Russia has medium to high risk, Panama, Ukraine, Antigua and Barbuda, and Turkey have medium risk level. Malta, Cyprus, Liberia, Italy, Greece, Luxembourg, Gibraltar, Netherlands, Bahamas, Denmark, Norway and Marshall Islands have medium to low risk level.

The flag states in Group II; Palau, Tuvalu, Kiribati and Dominica have a high risk level. Bolivia, Vanuatu, Egypt and Switzerland have medium to high risk. Thailand, Barbados, India, Netherlands Antilles, Philippines, Algeria, Syria, Lebanon, Libya, Korea Republic of, Lithuania, Spain have medium risk level. Bulgaria, United States, Azerbaijan, Germany, Croatia, Portugal, Sweden, Isle of Man, France, Bermuda, Belgium and China are labelled medium to low risk level.

Table 7. Performance point and risk level of flag states passing through the Straits.

Group I Flags	IPP	Risk Level
Tanzania	24	VHR
St. Kitts and Nevis	21	
Togo	20.5	
Sierra Leone	17.5	HR
Belize	17.5	
Comoros	17	
Moldova	16.5	
St. Vin. and The	16.5	
Cook Islands	15.5	
Cambodia	15	
Russia	11.5	M to HR
Panama	9.75	MR
Ukraine	9	
Antigua and Barb.	8.5	
Turkey	7.5	
Malta	5	M to LR
Cyprus	3.5	
Liberia	3.5	
Italy	3	
Luxembourg	2.5	
Greece	2	
Gibraltar	1.5	
Bahamas	1.5	
Netherlands	1.25	
Denmark	1.25	
Norway	1	
Marshall Islands	0.5	
Hong Kong	0	LR
Singapore	0	
United Kingdom	0	

Group II Flags	IPP	Risk Level
Palau	16.5	HR
Tuvalu	16	
Dominica	15.5	
Kiribati	15	
Bolivia	14	M to HR
Vanuatu	14	
Egypt	13.5	
Switzerland	10	
Thailand	9.5	MR
India	9	
Barbados	8.5	
Netherland Antilles	8	
Philippines	7.5	
Algeria	7	
Syria	7	
Lebanon	6.5	
Libya	6.5	
Korea (South)	6	
Spain	6	
Lithuania	5.5	
Bulgaria	5	M to LR
United States	5	
Azerbaijan	4	
Germany	3	
Croatia	3	
Portugal	2.5	
Sweden	2.5	
Isle of Man	2	
France	1.5	
Bermuda	1	
Belgium	1	
China	0.5	
Cayman Islands	0	LR

3.6 FLAG STATE'S RISK LEVEL

WRP values of flag states calculated using equation (1) are listed in Table 8. According to *WRP*, Turkey, Tanzania, Russia, Saint Kitts and Nevis, and Togo are classed as high risk level. On the other hand, Panama, Sierra Leone, Belize, Comoros, Moldova, Palau, Saint Vincent and the Grenadines, Tuvalu, Cook Islands, Cambodia, Kiribati, Dominica, Bolivia, Vanuatu, Egypt, Malta, and Switzerland are classed as standard risk level.

Table 8. *WRP* values and risk levels of flag states passing through the Straits.

High Risk Level		Standard Risk Level		Low Risk Level			
Flag	**WRP**	**Flag**	**WRP**	**Flag**	**WRP**	**Flag**	**WRP**
Turkey	7.50	Panama	4.88	Thailand	2.38	Germany	0.75
Tanzania	6.00	Sierra Leone	4.38	Ukraine	2.25	Croatia	0.75
Russia	5.75	Belize	4.38	India	2.25	Portugal	0.63
St. Kitts and Nevis	5.25	Comoros	4.25	Barbados	2.13	Sweden	0.63
Togo	5.13	Moldova	4.13	Antigua and Bar.	2.13	Luxembourg	0.63
		Palau	4.13	Netherland Antilles	2.00	Greece	0.50
		St. Vin. and The Gre.	4.13	Philippines	1.88	Isle of Man	0,50
		Tuvalu	4.00	Algeria	1.75	Gibraltar	0.38
		Cook Islands	3.88	Syria	1.75	Bahamas	0.38
		Dominica	3.88	Liberia	1.75	France	0.38
		Kiribati	3.75	Lebanon	1,63	Denmark	0.31
		Cambodia	3.75	Libya	1.63	Netherlands	0.31
		Bolivia	3.50	Korea (South)	1.50	Norway	0.25
		Vanuatu	3.50	Spain	1.50	Marshall Islands	0.25
		Egypt	3,38	Lithuania	1.38	Bermuda	0.25
		Malta	2.50	Bulgaria	1.25	Belgium	0.25
		Switzerland	2.50	United States	1.25	China	0.13
				Azerbaijan	1.00	Hong Kong	0,00
				Cyprus	0.88	Singapore	0,00
				Italy	0.75	United Kingdom	0,00
						Cayman Islands	0,00

3.7 THE ACCIDENTS OF FLAG STATES IN THE TURKISH STRAITS AND THEIR *IPP* AND *WRP* VALUES

According to the statistics of marine accidents /incidents of the Ministry of Transport, Maritime Affairs, and Communications, around 145 maritime incidents have occurred in the 2013-2015 (www.aakkm.udhb.gov.tr). These maritime incidents occurring in this periods are generally: contact, collision, grounding, listing, fire, capsizing, man falling to sea, health problems of crewmen, and work accidents either on the berth, deck, or in dry docks. Flag states that suffered accident in the Turkish Straits for the period 2013-2015 and their accident' rates are shown in Figure 4. The figure doesn't include the accidents of the Flag States related to weather condition and PSC irrelevant incidents.

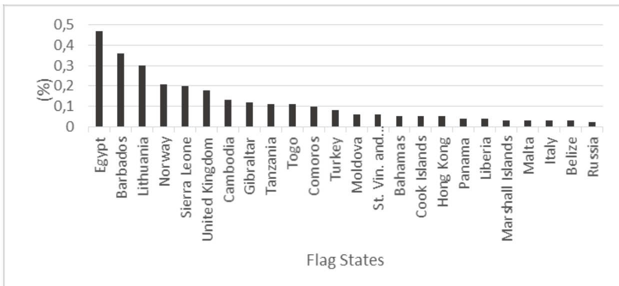

Figure 4. Flag states accidents rate in the Turkish Straits for the period 2013-2015.

Percentages of flag states that suffered maritime accidents in the Turkish Straits according to the *IPP* Risk levels and the *WRP* Risk levels are shown in Figure 5 (a) and (b). About 8.3% of all flag states having maritime accidents have very high risk levels in the *IPP* list. 29.2% of all flag states having maritime accidents have high levels in the *IPP* list. 8.3% of them have medium to high risk levels, 20.8% of them have medium risk levels. 25% of all flag states having maritime accidents are ranked as flags having medium to low risk level. Only, United Kingdom and Hong Kong have low risk level. While about 16.7% of all flag states having maritime accidents have high levels in the *WRP* list, 41.7% of them have standard risk levels.

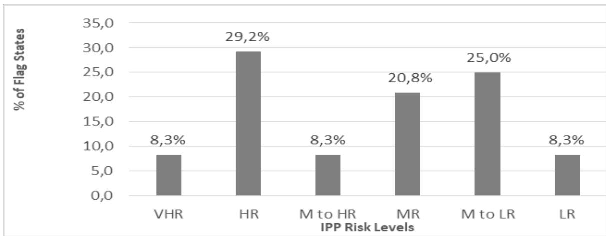

Figure 5a. Percentage of flag states having maritime accidents in the Turkish Straits according to the *IPP* Risk levels.

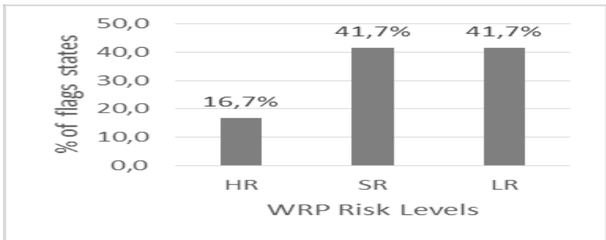

Figure 5b. Percentage of flag states having maritime accidents in the Turkish Straits according to the *WRP* Risk levels.

4. DISCUSSION

4.1 DETENTION INDEX AND DEFICIENCY INDEX RISK LEVELS OF FLAG STATES IN THE MOUs

Without any doubt, a high correlation between detention rates of the Paris MOU and the Tokyo MOU exists. In the same way, there is a very high correlation between the deficiency rates of the Paris MOU, the Mediterranean MOU, the Tokyo MOU and the Indian MOU. The Abuja MOU has a very low and a low correlation with all MOUs according to detention and deficiency rates.

A high correlation between the detention rates and the deficiency rates is apparent in the Paris MOU, the Indian Ocean MOU and the Abuja MOU. This result shows that there is a strong relationship between the detention of a ship and the deficiencies detected on that ship in these MOUs. All other MOUs have moderate correlation, except for the USGC. The USGC has a low correlation between detention and deficiency rates. This finding could indicate that the category of deficiency found in an inspection is an important factor to be taken in consideration for a ship detained in the USGC. Also, the findings of Knapp and van Velden had shown that the USGC was mostly separate from the other MOUs according to deficiency categories (Knapp & Velden, 2009).

Risk levels depending on the detention and deficiency indices of flag states are quite similar to one another in the Black Sea, the Mediterranean and the Paris MOUs; as well as, the Tokyo and the Indian Ocean MOUs. It is noteworthy here that the Black Sea and the Mediterranean and the Paris MOUs are regionally close to one another. The Tokyo and the Indian Ocean MOUs are close to each other, as well. A surprising result is that risk levels depending on detention rates of flag states in the Caribbean and the Riyadh MOUs are quite similar to each other, although these MOUs are regionally distant. This similarity could be attributed to the presence of many more flag states having detention values of zero in these MOUs.

The detention index risk levels of flag states in the Abuja MOU, the Viña del Mar Agreement, the USGC, the Caribbean MOU and the Riyadh MOU are distinctly different from other MOUs. For example, despite the fact that Moldova has a low risk level in the Riyadh MOU and the USGC, with a zero record, it has very high risk levels in all other MOUs that it is listed. In a similar manner, Comoros has a low risk level in the Abuja MOU and the Viña del Mar Agreement, whereas it has very high risk levels in other MOUs. While Cambodia has a low risk level in the Riyadh MOU, it has very high risk levels in other MOUs that it is listed. Moreover, while Tanzania has very high risk levels in almost all MOUs, it has a low risk level only in the Abuja MOU. In the same way, Luxembourg has a very high risk level in the Abuja MOU, whereas it has low risk levels in all other MOUs. Although Norway has a very high risk level in the Viña del Mar Agreement, in the mean while it has low risk levels in all other MOUs. Furthermore, the detention indices of some flags as Russia, Togo and Tanzania are very high values in the Abuja MOU, the Viña del Mar agreement and Riyadh MOU, because the regional detention rates of these MOUs are very small. One should note that Bolivia in the Tokyo MOU, Moldova in the Viña del Mar Agreement, Tanzania and Tuvalu in the Caribbean MOU were inspected one time only in this period. As a result of this inspection these flags were detained, and hence their detention index value in these MOUs are quite high. Most of flag states have detention values of 0 in the Abuja, the Riyadh and the Caribbean MOUs. In other words, ships flying their flags had not been detained during that specific period in these regions. Nonetheless, some of these flag states have very high or high risk levels in all other MOUs. While some of these results could be attributed to differences in inspections between MOUs, the others could be explained in terms of calling ships characteristics, as is the case with those of the findings of Cariou at. al. (Cariou, Mejia & Wolf, 2009).

Also the deficiency index risk levels of flag states in the Abuja MOU, the Viña del Mar Agreement, the USGC, the Caribbean MOU, and the Riyadh MOU are discernibly quite different from other MOUs. In the same way, there are flag states having very high risk only in the Abuja MOU, the Riyadh MOU, the Viña Del Mar Agreement and the USGC owing to the fact that these MOUs have small regional deficiency rates. Particularly, there are more flag states having very high risk in the Riyadh MOU.

In addition to these flag states that are indexed in Tables 7 and 8, there are about 60 flag states passing through the Straits, that they have less than 0.1% passing percentage. It should be noted that some of these flag states, such as Honduras and Mongolia, have a high index value in some MOUs.

4.2 *IPP* AND *WRP* VALUES OF FLAG STATES

According to *IPP*, there are not flag states having very high risk level in the Group II. While about 50% of flag states in the Group I have risk levels that are above medium to low risk; this value, on the other hand, is about 61% in the Group II. Flag states having very high risk, high risk and medium to high risk levels in the Group I constitute about 23% of all ships passing through the Turkish Straits. Flag states having medium risk level constitute about 33% of all ships passing there. Also, flag states having medium to low risk level constitute about 35% of all ships passing there. In the same way, flag states having high risk and medium to high risk levels in the Group II constitute approximately 1% of passing ships. Flag states having medium risk levels constitute approximately 2% of all passing ships. In brief, about 59% of all ships passing through the Turkish Straits are risky ships that have above medium to low risk level. In other words, at least 59 % of all ships passing through the Turkish Straits are sub-standard ships. These findings comply with the findings about sub-standard ships in the Black sea region of Bang, Piniella et al., and Bang and Jang (Bang & Jang, 2012; Bang, 2008; Piniella, Rodriguez & Alcaide, 2014). But, the findings of Emecen Kara (Emecen Kara, 2016) have indicated that there are a declining trend from 2009 in the risk level of black-listed flags in the Black Sea MOU region.

According to *WRP*, Turkey, which has the most risk value, is classified as high risk status in the ranking of *WRP* due to high passing rate. However, Turkey is classified as medium risk level in the *IPP* ranking. Similarly, Russia that is classified as high risk status in the ranking of *WRP* is listed medium to high risk level in the *IPP* ranking.

According to the ranking of accidents rates of flag states in the Straits, Egypt, Barbados and Lithuania are the top three flag states. These flags that are listed Group II have between 0.5% and 0.1% passing percentage. In the *IPP* list, Egypt has medium to high risk level, Barbados and Lithuania have medium risk level. About 67% of all flag states having maritime accidents have a risk level that is above risk medium to low risk level in the *IPP* list. In the same way, all flag states classified as high risk level in the *WRP* list have had maritime accidents in this period, with the exception of St. Kitts and Navis. Also, while 41% of all flag states classified as standard risk levels in the *WRP* are found to have had maritime accidents. This value is 24% for flag states ranked as low risk levels.

5. CONCLUSIONS

There are a high correlation between the detention rates of the Paris MOU and the Tokyo MOU. In the same way, a very high correlation between deficiency rates of the Paris MOU, the Mediterranean MOU, the Tokyo MOU and the Indian MOU exits. The Abuja MOU has the lowest correlation with all MOUs according to detention and deficiency rates. The risk levels of flag states on the basis of their detention and deficiency indices are significantly similar to each other in the Black Sea, the Mediterranean and the Paris MOUs; as well as, in the Tokyo and the Indian Ocean MOUs. The Abuja MOU, the Viña del Mar Agreement, the USGC, the Caribbean MOU and the Riyadh MOU are quite separate from these MOUs, according to these flag states risk levels.

About 120 different flag states have passed through the Turkish Straits during this period. 30 of these flag states have a passing percentage of 0.5% or more. Turkey, Malta, Panama, Russia, Liberia and Marshall Islands are flag states having passing percentage of 5% or more. Turkey, Malta, Panama, Russia, Liberia and Marshall Islands are ranked as having medium to lower risk levels in the *IPP*. Only one of these, Russia, has a medium to high risk level in this ranking. According to *IPP*, Tanzania, Saint Kitts and Nevis, and Togo are flag states having a very high risk level. Flags that are classified as having very high, high, medium to high and medium risk levels in the *IPP* ranking comprise about 59% of all ships passing through the Turkish Straits. According to *WRP*, Turkey, Tanzania, Russia, Saint Kitts and Nevis and Togo are flag states having a high risk level. Turkey and Russia are classified as high risk status in this ranking due to high passing rate.

A total of 24 flag states suffered maritime accidents in the Straits region, with the exception of accidents occurring due to weather condition. The *IPP* and *WRP* results, thus obtained, are in accord with these maritime accidents occurring in this region. It is clearly apparent that approximately 67% of these flag states that suffered maritime accidents in this region have medium to higher risk levels in the *IPP* list, with 8.3% of them have very high risk levels. By the same comparisons, 58% of these flag states that suffered maritime accidents in this region are ranked as having standard and high risk levels in the *WRP*.

The development of a more effective and sustainable inspection mechanism and the implementation of it in the all MOUs will ensure the elimination of sub-standard ships in the world seas over time. All regional MOUs must implement a risk based targeting and inspection system that is in ways similar to the Paris, the Tokyo MOUs and the USCG. Furthermore, the reduction in disparity between regional MOUs would be, without doubt, successful in the elimination of substandard ships by barring ships moving to regions where PSC is exercised less strictly. In particular, the efficiency and effectiveness of the Black Sea MOU and the Mediterranean MOU inspections are extremely important for enhancing in maritime safety in the Turkish Straits.

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APPENDICES

Table 3a. Calculated detention indexes of Group I.

FLAG	Paris MOU	Tokyo MOU	Black Sea MOU	Indian Ocean MOU	Medi-terranean MOU	Abuja MOU	Carib bean MOU	USCG	Vina Del Mar Agreement	Riyadh MOU
Turkey	1.28	0.96	1.22	0.64	0.55	3.78	0.00	1.56	0.97	0.00
Malta	0.89	1.07	0.34	1.00	0.50	0.00	0.79	1.06	0.50	0.45
Panama	1.48	0.97	0.96	1.07	0.94	1.77	1.34	1.37	1.39	1.25
Liberia	0.80	1.01	0.36	1.07	0.26	0.89	0.00	0.88	0.72	1.06
Russia	1.37	1.33	1.13		2.06	30.27		0.00	0.00	0.00
Marshall Islands	0.47	0.59	0.43	0.71	0.28	0.83	0.26	0.58	0.50	0.45
Antigua and Barb.	1.23	1.39	0.46	1.92	0.78	0.51	1.17	1.61	1.07	0.38
Moldova	4.16		3.09	7.98	4.00		35.25	0.00	103.93	0.00
Cambodia	3.07	3.34	2.36	3.55	4.54					0.00
Belize	2.90	2.03	1.05	3.68	1.92	3.61	0.00	14.96	4.33	0.00
Italy	0.34	1.14	0.10	0.99	0.47	0.00	1.43	0.58	0.59	0.00
Greece	0.57	0.92	0.14	1.25	0.59	0.00	0.00	1.28	0.21	0.00
Netherlands	0.49	0.36	0.00	0.51	0.43	1.25	0.00	0.68	0.66	0.00
Bahamas	0.38	0.67	0.70	0.73	0.12	0.68	1.05	0.64	0.54	0.27
Cook Islands	3.35	2.86	1.42	2.45	1.91	0.00	0.00	0.00	13.56	0.00
Hong Kong	0.35	0.28	0.17	0.63	0.16	0.00	0.64	0.55	0.46	0.79
Singapore	0.40	0.23	0.25	0.60	0.09	0.50	0.50	0.68	0.15	0.43
Ukraine	1.97		2.74		2.60				0.00	
Sierra Leone	2.91	4.59	1.86	5.58	2.90		17.63		0.00	9.62
Togo	4.14	2.94	3.01	2.75	1.94	25.49	0.00	0.00	11.55	28.85
Tanzania	5.12	5.12	3.69	5.74	3.84	0.00	52.88	6.51	29.69	22.27
St. Vin. and The Gre.	2.62	0.80	1.91	1.78	1.66	0.00	5.08	5.04	5.30	1.82
Comoros	3.73	14.56	2.39	3.42	2.70	0.00			0.00	3.53
St. Kitts and Nevis	2.98	2.29	1.41	10.64	1.47	0.00	2.40	4.60	12.99	10.80
Denmark	0.23	0.58	0.40	0.41	0.38	1.77	0.00	0.41	0.00	0.00
Gibraltar	0.60	0.97	0.38	0.61	0.16	0.00	0.00	0.51	0.00	0.00
Cyprus	0.89	0.92	0.51	1.11	0.29	2.11	0.00	1.51	0.68	0.00
United Kingdom	0.20	0.55	0.41	0.55	0.27	0.00	0.00	0.00	0.00	0.00
Luxembourg	0.40	0.54	0.00	0.73	0.41	2.88	0.00	0.00	0.00	0.00
Norway	0.30	0.47	0.34	0.21	0.00	0.00	0.00	0.65	12.99	0.00

Table 3b. Calculated detention indexes of Group II.

FLAG	Paris MOU	Tokyo MOU	Black Sea MOU	Indian Ocean MOU	Medi-terranean MOU	Abuja MOU	Carib bean MOU	USCG	Vina Del Mar Agreement	Riyadh MOU
Vanuatu	2.56	1.45	1.08	0.89	1.51	2.52	0.00	1.54	7.17	0.00
Bulgaria	1.44		1.35		0.00			0.00		
Palau	3.45	3.09	4.35	9.97	3.05			0.00		21.16
China	0.26	0.10	0.40	0.28	0.16	0.00	0.00	0.72	0.51	0.00
Isle of Man	0.36	0.70	0.72	0.48	0.22	0.00	0.00	1.00	0.00	0.00
Lebanon	1.64		1.08		0.72				1.51	
Portugal	0.87	0.65	0.00	1.10	0.00	0.00	0.00	0.97	1.70	0.00
Cayman Islands	0.32	0.46	0.00	0.46	0.00	0.00	0.00	0.19	0.00	0.00
Lithuania	1.34	0.00	0.00		1.00	0.00	0.00	0.00	5.77	
Bermuda	0.25	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Algeria	2.72		0.00		2.25			0.00		
Barbados	0.66	1.12	0.00	1.60	1.08		0.00	1.13	0.00	0.00
Tuvalu	3.84	0.98	1.66	2.04	1.35		52.88	0.00	6.50	3.92
Egypt	2.17	4.50	0.74	2.66	1.38			7.48	0.00	0.00
Germany	0.37	0.74	0.00	1.56	0.00	0.00	0.00	0.65	1.73	0.00
NetherlandsAnt.	2.43	0.38	0.00	0.00	0.38	0,00	2.52	0.97	2.97	0.00
Croatia	0.23	0.00	0.00	0.00	0.86	0,00		1.46	0.00	11.76
United States	0.42	0.17	0.00	0.46	0.60	0,00	1.96		0.00	0.00
Belgium	0.28	0.00	0.00	0.00	0.69	0,00	0.00	0.00	0.00	0.00
Philippines	0.19	1.82	0.00	0.80	0.00	0,00	0.00	0.47	1.81	0.00
France	0.00	0.00	0.00	0.00	0.60	0,00	0.00	0.81	0.00	0.00
Thailand	1.54	1.18	0.00	1.10	0.00	0,00	0.00	3.59	0.00	0.00
Libya	2.11	0.00	0.00		4.49	0,00		0.00	0.00	0.00
Syria	1.80		1.61		2.57					
Korea, Rep. of	0.61	0.13	1.31	1.03	0.00	0,00		0.00		0.85
Switzerland	0.96	0.85	2.29	1.03	1.74	0,00	4.41	0.00	1.24	0.00
Kiribati	7.20	2.40	5.14	0.00	1.63	0,00		0.00	17.32	0.00
India	0.78	1.57	1.25	0.94	0.00	0,00	0.00	1.33	0.00	2.10
Spain	1.04	4.12	0.00		0.83	0,00	0.00	0.00	0.00	
Bolivia	10.80	24.75	0.00	0.00	5.14		0.00	15.75		
Sweden	0.00	1.14	0.00	1.06	0.00	0,00		1.30	0.00	0.00
Azerbaijan	1.92		0.00		8.99					
Dominica	4.91	2.54	0.00	2.90	2.12	0,00	7.55	0.00	0.00	0.00

*Flags are ranked according to percentage of passing. Group I comprises flag states that have 0.5 % or more passing percentage, Group II comprises flag states that have between 0.5 % and 0.1 % passing percentage. Blue colour boxes represent high risk, orange colour boxes represent very high risk.

Table 4a. Calculated deficiency indexes of Group I.

FLAG	Paris MOU	Tokyo MOU	Black Sea MOU	Indian Ocean MOU	Medi-terranean MOU	Abuja MOU	Carib bean MOU	USCG	Vina Del Mar Agreement	Riyadh MOU
Turkey	1.09	0.68	1.09	0.91	1.19	1.61	0.00	0.97	1.11	0.99
Malta	0.98	0.92	0.78	1.02	0.83	0.90	1.19	1.01	1.06	0.76
Panama	1.08	0.99	1.02	1.08	0.98	1.16	1.01	1.03	1.06	1.12
Liberia	0.90	0.94	0.79	0.91	0.72	1.16	0.79	1.05	1.01	0.75
Russia	1.12	1.46	1.13		1.27	8.56		1.74	1.11	0.89
Marshall Islands	0.81	0.81	0.73	0.92	0.61	0.92	1.11	0.96	0.95	0.90
Antigua and Barb.	1.11	1.05	0.99	1.14	0.91	0.50	0.81	1.24	1.10	0.96
Moldova	1.71		1.56	1.65	1.73		1.64	3.48	3.60	2.69
Cambodia	1.67	1.59	1.54	1.80	1.74					2.23
Belize	1.51	1.51	1.35	1.57	1.51	1.53	0.00	1.30	1.80	1.86
Italy	0.95	0.94	0.74	0.89	0.60	0.59	1.19	1.29	1.14	0.48
Greece	0.79	0.81	0.46	0.88	0.58	0.33	1.41	0.83	0.73	0.66
Netherlands	0.91	0.76	0.68	0.85	0.77	0.44	0.26	1.12	1.04	0.71
Bahamas	0.93	0.81	0.80	0.91	0.66	1.00	1.25	0.97	0.78	0.64
Cook Islands	1.48	0.98	1.31	1.52	1.59	1.14	2.45	2.20	1.72	1.36
Hong Kong	0.86	0.80	0.53	0.97	0.43	0.58	0.48	0.80	0.84	0.96
Singapore	0.82	0.76	0.74	0.90	0.44	0.92	0.68	0.85	0.74	0.77
Ukraine	1.53		1.28		1.36				3.60	
Sierra Leone	1.68	1.57	1.53	1.53	1.72		2.45		1.80	3.64
Togo	1.67	1.59	1.61	1.24	1.78	6.31	2.45	2.32	2.80	2.83
Tanzania	1.71	1.52	1.56	1.33	1.82	2.05	2,45	2.72	3.34	3.75
St. Vin. and The Gre.	1.31	1.46	1.31	1.37	1.48	1.66	1.60	1.43	1.36	1.58
Comoros	1.72	1.63	1.51	1.28	1.71	1.14			1.44	2.37
St. Kitts and Nevis	1.44	1.55	1.31	1.74	1.61	1.21	1.78	2.14	2.02	3.09
Denmark	0.71	0.93	1.02	0.81	0.70	0.87	0.87	0.86	0.69	0.81
Gibraltar	0.99	0.84	0.92	0.88	0.79	0.00	0.92	1.00	1.01	1.18
Cyprus	0.99	0.92	0.74	1.18	0.80	0.67	0.52	1.08	0.96	0.70
United Kingdom	0.91	0.91	0.94	0.87	0.74	0.30	0.79	0.82	0.58	0.42
Luxembourg	0.83	0.96	0.71	0.82	0.64	2.85	1.12	1.16	0.84	0.61
Norway	0.90	0.79	0.62	0.74	0.62	0.89	0.23	0.96	0.45	0.39

Table 4 b. Calculated deficiency indexes of Group II.

FLAG	Paris MOU	Tokyo MOU	Black Sea MOU	Indian Ocean MOU	Medi-terranean MOU	Abuja MOU	Carib bean MOU	USCG	Vina Del Mar Agreement	Riyadh MOU
Vanuatu	1.32	1.05	1.33	1.20	0.96	3.21	0.49	1.30	1.37	1.53
Bulgaria	1.58		1.06		1.65			0.00		
Palau	1.61	1.38	1,60	1.80	1.85			1.74		2.67
China	0.86	0.77	0.36	0.93	0.32	0.55	0.74	0.85	0.60	1.06
Isle of Man	0.76	0.76	0.63	0.74	0.86	1.32	1.04	0.95	0.78	0.47
Lebanon	1.65		1.39		1.57				2.14	
Portugal	0.98	1.00	0.80	0.99	0.78	0.86	0.20	0.93	0.77	1.27
Cayman Islands	0.79	0.57	0.61	0.58	0.64	0.00	0.82	0.63	0.92	0.44
Lithuania	0.88	0.81	0.69		1.31	0.80	0.00	1.96	2.20	
Bermuda	0.75	0.72	0.41	0.90	0.59	0.00	1.75	1.25	0.63	0.30
Algeria	1.34		1.65		0.70			2.32		
Barbados	1.00	1.07	1.19	0.90	1.12		0.70	1.25	1.20	0.00
Tuvalu	1.62	1.33	1.35	1.11	1.52		2.45	0.00	2.70	2.47
Egypt	1.33	1.38	1.25	1.50	1.43			1.74	0.60	0.25
Germany	0.81	1.06	1.05	0.57	0.67	0.00	0.38	0.96	0.88	0.73
Netherlands Ant.	1.26	0.68	1.42	0.60	0.87	1.22	0.93	0.67	1.44	2.97
Croatia	0.82	0.75	0.36	0.77	0.78	1.90		1.10	0.88	0.99
United States	1.16	1.14	0.00	0.67	1.22	1.51	1.00		1.48	0.95
Belgium	0.91	0.71	0.46	0.75	0.93	0.82	0.82	0.76	1.04	1.48
Philippines	1.17	1.15	1.08	1.20	0.85	0.46	2.45	1.06	1.38	0.98
France	0.96	0.96	0.83	0.48	0.69	1.22	1.34	1.13	0.80	0.64
Thailand	1.03	1.20	0.91	1.30	1.02	0.00	0.27	1.39	1.25	0.74
Libya	1.10	0.72	0.68		1.03	0.00		1.45	0.90	0.00
Syria	1.58		1.26		1.85					
Korea, Rep. of	1.27	1.22	0.79	1.10	0.87	0.68		1.41	1.51	1.75
Switzerland	1.17	0.92	1.10	1.10	0.89	0.57	1.02	1.18	1.29	1.65
Kiribati	1.69	1.42	1.45	1.80	1.73	0.00		2.17	0.60	4.45
India	0.85	0.96	0.98	1.01	1.30	5.27	1.23	1.16	1.65	1.39
Spain	0.92	0.81	0.83		0.65	2.45	2.45	1.04	1.20	
Bolivia	1.80	1.63	0.68	1.80	1.85		2.45	2.56		
Sweden	0.66	0.60	0.00	0.42	0.84	0.00		0.68	0.36	0.00
Azerbaijan	1.44		0.55		0.93					
Dominica	1.36	1.38	1.45	1.14	1.53	8.56	2.45	1.30	0.00	0.99