

# *Evaluation of PSC on Container Ships Under Improved NIR Ship Targeting Model*

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**Abstract:** Based on Improved New Inspection Regime (I-NIR) ship targeting model of Tokyo MoU, the impact of Port State Control (PSC) on container ships was assessed. Ship targeting is the first step in PSC. The proper method to target ship can help to find sub-standard ships and improve inspection efficiency. Through analyzing the data in recent 6 years, comparing the PSC overview of container ships both under old as well as new NIR models, and taking advantages of case study to evaluate the impact on ship risk level, the results show that I-NIR has a great impact on the inspection frequency and risk level of container ships in the Asia-Pacific region. Relevant shipping companies should actively adjust the strategy to prepare for PSC with the new characteristics under I-NIR.

## 1. Introduction

As one of the important parts in the maritime safety management, Port State Control (PSC) is regarded as the "last line of defense" of maritime safety. With the continuous development of PSC, the Tokyo MoU officially launched a new ship risk assessment and ship targeting scheme - New Inspection Regime (NIR) [1] on January 1, 2014 in order to combat low standard ships more accurately.

Target ship with the proper method is the basis to conduct PSC efficiently. Based on the operation of NIR in recent years, the Tokyo MoU has once again optimized this scheme and started to use the newly Improved NIR (I-NIR) model in 2018. On the basis of the I-NIR ship targeting model in Tokyo MoU, this paper focuses on the research and calculation of the impact to container ship inspection. Per analysis of the characteristics of the new model, this paper deeper evaluates impact behind this change, which is helpful to the research on the PSC trend of container ships in Asia-Pacific region.

Vessel targeting is the first step of PSC, that is, according to the requirements in inspection procedure, the PSC offices analyze the main particulars and historical characteristics of the arriving vessels, select the potential sub-standard vessel for inspection. Therefore, a reasonable ship targeting method can effectively improve the PSC's efficiency for resources allocation, to find unseaworthy ships that do not meet the requirements of the IMO regulations in limited time for

inspection.

Under the NIR scheme of Tokyo MoU, the main factors to be considered to target ship are: ship type, age, classification society, flag state, Management Company, inspection times, deficiency, detention, etc. The overall evaluation system of the newly I-NIR model is shown in Table 1, which divides ships into three risk levels: high, standard and low. In order to be a low-risk ship, the ship must meet all the requirements in the low-risk standard. If the risk weighting point reaches 4, the ship will be considered as high-risked; the rest of the ships are of standard-risked. In particular, it should be pointed out that classification society, flag state and Management Company can be referred to as overall indicators [2], while all other indicators can be referred to as individual indicators. The individual indicator is directly determined by the ship herself, while the overall indicator is not only influenced by the ship herself, but also indirectly affected by the performance of other ships in the fleet. For example, if the management performance of one management company is uneven, even if the management of the individual ship is good, but the maintenance of other ships is not in place, the management performance of the whole company will be rated as "Very Low". In this case, the PSC risk rating of all individual ships will be greatly affected. During evaluating classification society and flag state, similar situations occur as well.

Table 1 Ship Risk Profile

Parameter		High Risk Ship (HRS)		Low Risk Ship (LRS)	Standard Risk Ship (SRS)
		Criteria	Weighting point	Criteria	
Type of ship		Chemical tanker Gas carrier Oil tanker Bulk carrier Passenger ship Container	2	-	Neither a high risk nor a low risk ship
Age of ship		>12 years	1	-	
Flag	BGW-List	Black	1	White	
	IMO-Audit	-	-	Yes	
Recognized Organization	RO of Tokyo MOU	-	-	Yes	
	Performance	Low	1	High	
Very low					
Company performance		Low	2	High	
		Very low			
		No insp. in previous 36 months			
Number of Def. in each insp. in previous 36 months		>5 Def.	Insp. Number	Insp. Number=0 (>1 insp. in previous 36 months)	
Number of Det. in previous 36 months		≥3 Det.	1	No Det.	

In principle, the ship's inspection time-window is shown in Table 2. The inspection period will continuously shorten as the ship's risk level increases. It is obviously to find that the longest inspection window for low-risk ships is up to 18 months, while the shortest inspection window for high-risk ships is only 2 months, that is, if the former is only inspected for 1 time, the latter will be inspected at most 9 times in the same period. This ship targeting scheme will lead to higher intensity and frequency inspection for high-risk ships by PSC, and also urge shipping companies to value and pay more attention to PSC records, to achieve more reasonable allocation of PSC

resources. Additionally, PSC has the right to inspect the ship immediately outside the time-window in the event of special conditions or clear ground, such as main engine not under command, marine pollution accidents, container stowage problems, etc.

*Table 2 Selection Scheme*

Priority	Time Window	Note
I Ship must be inspected	HRS not inspected in last 4 months	Overriding priority might trigger inspection immediately
	SRS not inspected in last 8 months	
	LRS not inspected in last 18 months	
II Ship may be inspected	HRS not inspected in last 2 months	
	SRS not inspected in last 5 months	
	LRS not inspected in last 9 months	

## 2. Impact of I-NIR on Container Ships

The modification and optimization of NIR was the topic raised at the 27th PSCC meeting in Tokyo MoU, during which the risk weighting point for container ships was deeply discussed. In original NIR model, considering that most of container shipping companies are large enterprises and focus on the ship maintenance, hence container ships are regarded as low-risk ships without giving risk weight factors.

However, with the development of the shipping industry and the feedback from the inspection results of PSC, some member states of Tokyo MoU pointed out that due to the frequent berthing operation of container ships, crew fatigue easily occurred, which would lead to accidents [3]. On the other hand, with the rapid development of large-scale container ships, large amount of fuel carried by these container ships in the event of an accident is likely to bring immeasurable and serious damage to the environment. Therefore, as shown in Table 3 [4], after the modification of NIR scheme, the container ship was given a risk weighting point of 2 points. Thus, the main ship types in maritime industry such as bulk carriers, oil tankers, chemical tankers and container ships were all classified as high-risk ships in I-NIR.

*Table 3 Original NIR vs I-NIR*

Parameters	Original NIR	I-NIR	Criteria Weighting Point
Type of ship	Chemical tanker/Gas carrier/Oil tanker Bulk carrier/Passenger ship	Chemical tanker/Gas carrier/Oil tanker Bulk carrier/Passenger ship/Container	2
Company performance	Low	Low	2
	Very low	Very low	
		No insp. in previous 36 months	

In addition to the changes in container ships, the modified ratings for the management company also bring new requirements for container ship companies. Under the original NIR scheme, a management company would be considered as "Medium Performance" if it had not been inspected by a PSC in Tokyo MoU region during the previous 36 months, i.e., the management company would not be assigned a risk weight factor. In the I-NIR model in Table 3, if the same situation exists in Management Company, it will be given a risk weighting point of 2 points, which will directly have a broad impact on inspection time-window for the company's whole fleet. These changes reflect the focus of Tokyo MoU on the trend of ship types and new companies when

entering the Asia-Pacific region. They also reflect the trend of stricter inspection standards in PSC, which has a significant impact on the frequency and intensity of inspection for container ships under some special conditions. Furthermore, due to the mandatory implementation of IMO's formal audit, the newly I-NIR deleted the risk weighting point of IMO Voluntary Audit Scheme (VIMSAS) from the flag state criteria, and the impact of this change was relatively limited, which would not discuss in detail.

### 3. Case Study under Original NIR and I-NIR

The original NIR model was implemented on January 1, 2014, while the I-NIR model was implemented on February 1, 2018. Therefore, to analyze the differences under old and new NIR models, the inspection data of container ships in APCIS[5] database of Tokyo MoU was extracted from January 1, 2014 to January 31, 2018 (total 49 months), and from February 1, 2018 to December 31, 2019 (total 23 months). The comparison results of the key indexes for inspection and detention were shown in Figure 1 and Figure 2.

As shown in Figure 1, after the implementation of the I-NIR model, the inspection for container ships in Tokyo MoU increased from an average of 413.96 vessels per month to 469.61 vessels per month, increasing of 13.44%. Among all inspections, the number of inspections with deficiencies rose from 229.56 vessels per month to 247.09 vessels per month, increasing of 7.64%. Therefore, it can be observed from the results that the inspection frequency and intensity of container ships have increased obviously, which is also consistent with the improvement trend of NIR ship targeting model.

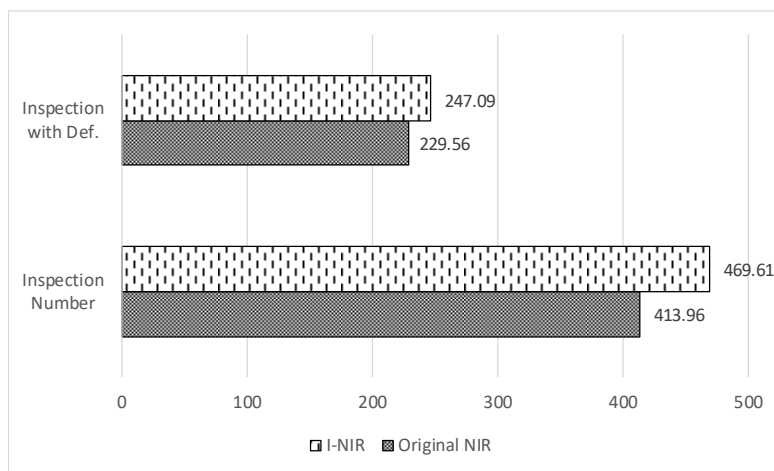
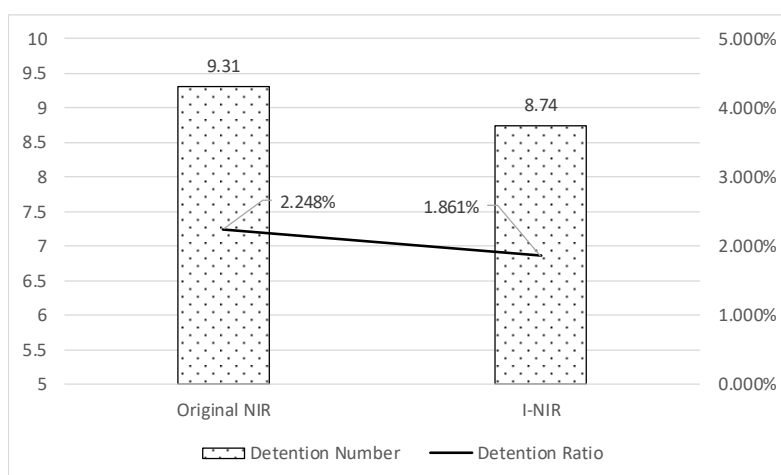


Figure. 1 Monthly PSC Inspection Index



*Figure. 1 Monthly PSC Detention Index*

As can be seen from Figure 2 that, after the I-NIR model developed, the number of detention for container ships in the Tokyo MoU decreased from 9.31 vessels per month to 8.74 vessels per month on average, decreasing of 6.12%. Meanwhile, the overall detention ratio dropped from 2.248% to 1.861%, a decline of 12.77%. From this result, on the one hand, with the inspection increasingly strengthened, the container ship's overall detention ratio improve instead, which further illustrates the positive management on fleet maintenance kept by container ship companies. On the other hand, this also reminds PSC offices that ship targeting should combine with the characteristics of local jurisdiction, instead of pursuing inspection amount for blind.

In case study, a container ship selected (Ship's particular in Table 4) to indicate the difference of ship targeting result under both original NIR and I-NIR models. From the calculation and results in Table 5, it can be seen that under the original NIR model, the Criteria Weighting Point (CWP) of this container ship is 0, performed as a low-risk ship. However, under the I-NIR model, CWP was raised to 4, reaching high risk level. From the perspective of parameters, the reason for the final risk level difference is due to the major two factors mentioned above, namely, container ships classified with a risk weighting point of 2, and the company whose weighting point is adjusted to 2 due to not inspected in Tokyo MoU for the past 36 months. Through this example, it can be obviously found that the adjustment of only a few parameters can bring great changes to inspection frequency of container ships, which is a situation that container ship companies must adapt to and cope with.

*Table 4 Ship's Particular*

Parameter	Particular
Type	Container
Age	1
Flag	Liberia (White)
RO	DNV-GL (High)
Company Performance	Last inspection in 2016.7
>5 Def. in each Inspection	0
≥3 Detention	0

Table 5 Calculation & Result (Original NIR vs I-NIR)

Parameter	Criteria Weighting Point (CWP)	
	Original NIR	Revised NIR
Type of ship	0	2
Age of ship	0	0
Flag	BGW-List	0
	IMO-Audit	Yes
Recognized Organization	RO of Tokyo MOU	Yes
	Performance	High
Company performance	0 (Medium)	2
>5 Def. in each insp. in previous 36 months	0	0
≥3 Det. in previous 36 months	0	0
Result	Low Risk Ship (CWP=0)	High Risk Ship (CWP=4)

#### 4. Conclusion

The I-NIR model is the improvement and optimization for PSC ship targeting procedure in Tokyo MoU. As the first step to target sub-standard ships, a reasonable ship targeting method can greatly improve the efficiency of PSC. By analyzing historical inspection data and specific example in Asia-Pacific region, it can provide reference for container shipping companies to adapt to the inspection changes under the new scheme. Relevant results show that:

1. According to the analysis of the data in the past 72 months, the inspection frequency and intensity of container ships have increased significantly under the new model, with the average monthly vessel inspection and the inspection conducted with deficiency increasing by 13.44% and 7.64% respectively;

2. Based on the case study, the change of risk weighting point in ship type and Management Company in the new regime will directly lead to adjustment of risk level for some container ships from low-risked to high-risked. In other words, the inspection time-window of those ships will be decreased to 2 months from 18 months in I-NIR.

The above conclusion, reflect to the development trend of PSC in Asia-Pacific region and even around the world, have a direct impact on inspection intensity for special ships under certain conditions. These research results have reference value for container ship companies to adjust their PSC strategy.

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