INVESTIGATION OF DEFICIENCIES ARISING FROM BALLAST WATER MANAGEMENT CONVENTION IN CONTROLS OF OIL AND CHEMICAL TANKERS

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İSTİLACI YABANCI TÜRLERLE MÜCADELEDE BALAST SUYU VE BİYOFOULİNG YÖNETİMİ
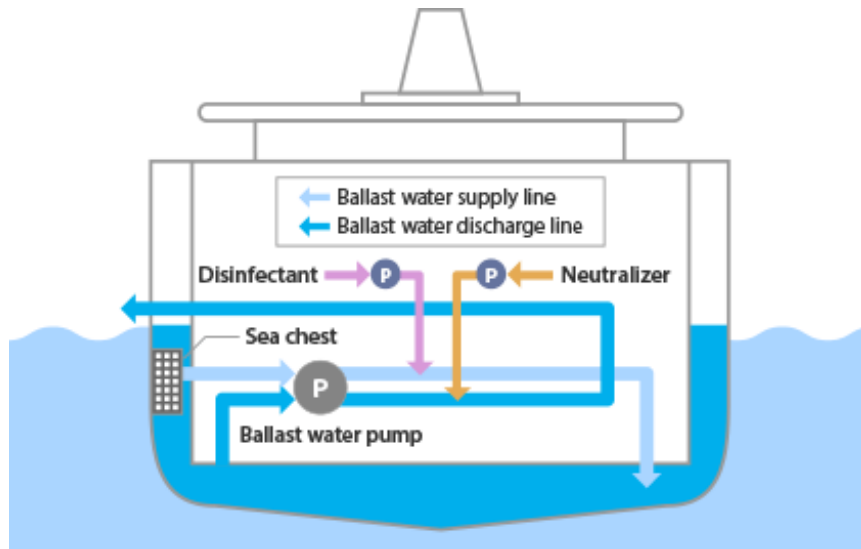Uluslararası Sempozyumu

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ANTALYA, TÜRKİYE

CONTENT

Ballast Water Management

- Scientists first recognized the signs of an alien species introduction after a mass occurrence of the Asian phytoplankton algae Odontella in the North Sea in 1903.

- In the late 1980s, Canada and Australia were among countries experiencing particular problems with invasive species, and they brought their concerns to the attention of IMO's Marine Environment Protection Committee (MEPC).

- IMO has been at the forefront of the international effort by taking the lead in addressing the transfer of invasive aquatic species through shipping and In 1991 adopted the *International Guidelines for Preventing the Introduction of Unwanted Aquatic Organisms and Pathogens from Ships' Ballast Water and Sediment Discharges* (resolution MEPC.50(31)).

Ballast Water Management

Complying with the **Ballast Water Management Convention**
Stopping the spread of invasive aquatic species

- The International Convention for the Control and Management of Ships' Ballast Water and Sediments (BWM Convention) was adopted by consensus at a Diplomatic Conference held at IMO Headquarters in London on 13 February 2004.

- The International Convention for the Control and Management of Ships' Ballast Water and Sediments, 2004 (BWM Convention), entered into force globally on 8 September 2017.

D1 standard requiring ships to exchange ballast water in open seas, away from coastal areas. Few organisms survive.

D2 standard specifying the maximum amount of viable organisms allowed to be discharged, including specified indicator microbes harmful to human health. Usually involves installing ballast water management system.

BACKGROUND INFO

- All new ships must conform to the D2 standard.
- Until the date when they have to meet the D2 standard, existing ships should exchange ballast water mid-ocean, to meet the D1 standard.
- Over time, all ships will have to meet the D2 standard.
- 'Renewal survey' refers to the IOPPC renewal survey under MARPOL Annex I

All ships must meet D2 standard by 8 September 2024.

Existing ships with renewal survey after 8 September 2019 must meet D2 standard by this renewal survey.

Existing ships with renewal survey between 8 September 2017 and 8 September 2019

Case 1: if previous renewal survey was between 8 September 2014 and 8 September 2017 – must comply with D2 by this renewal survey.

Case 2: if previous renewal survey was before 8 September 2014 – then compliance with D2 must be by the next renewal survey.

New ships built on or after 8 September 2017 must meet the D2 standard.

Existing ships built prior to 8 September 2017 must meet the D1 standard until their D2 compliance date.

All ships must have:
- ballast water management plan
- ballast water record book
- International Ballast Water Management Certificate

2024 ✓
2019 ✓
2017 ✓

D2 STANDARD
D1 STANDARD
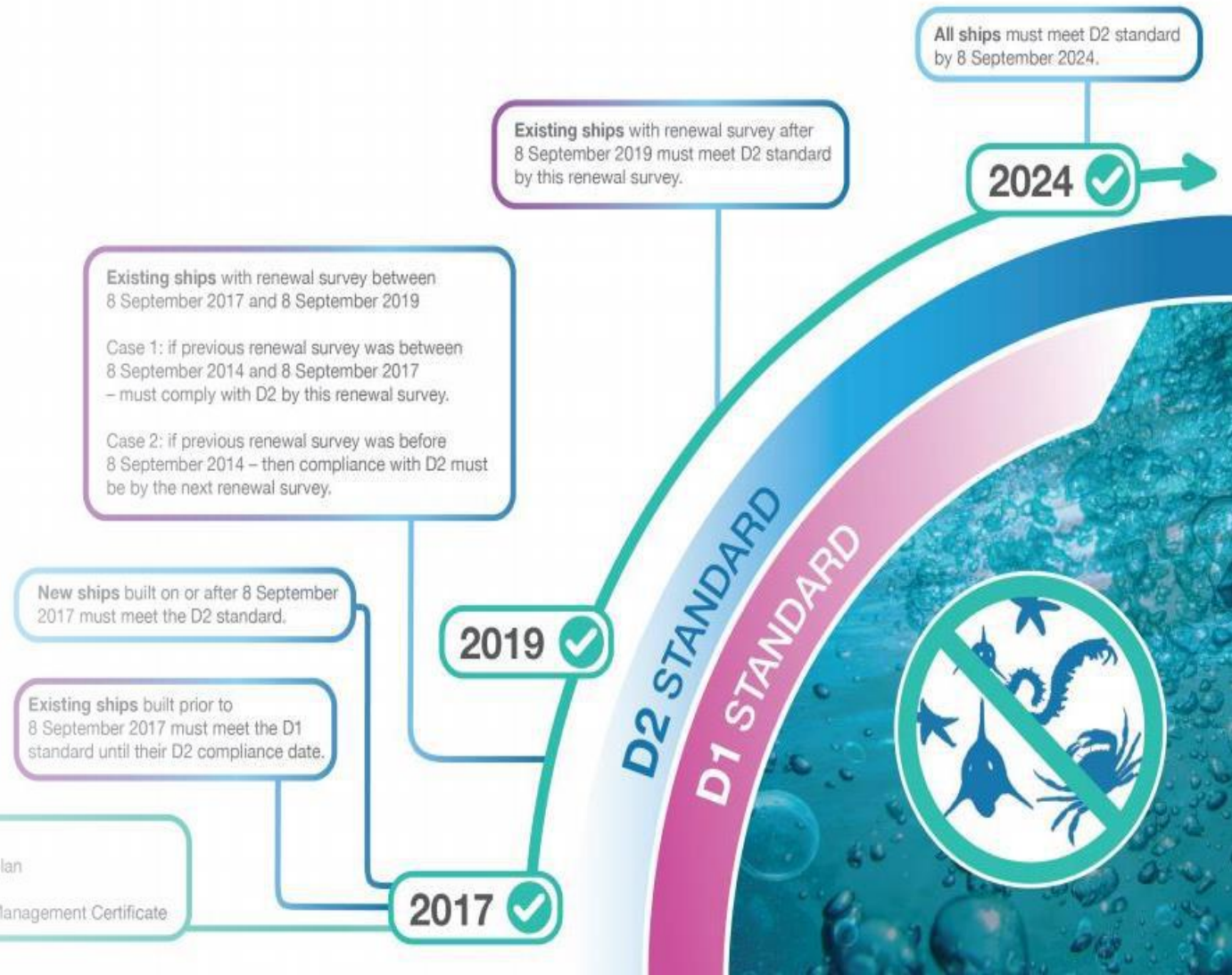
Port State Control

- Port State Control (PSC) is the inspection of foreign ships in national ports to verify that the condition of the ship and its equipment comply with the requirements of international regulations and that the ship is manned and operated in compliance with these rules.

- Nine regional agreements on port State control - Memoranda of Understanding (MoUs) - have been signed:

  - Europe and the north Atlantic (Paris MoU);

  - Asia and the Pacific (Tokyo MoU);

  - Latin America (Acuerdo de Viña del Mar);

  - Caribbean (Caribbean MoU);

  - West and Central Africa (Abuja MoU);

  - the Black Sea region (Black Sea MoU);

  - the Mediterranean (Mediterranean MoU);

  - the Indian Ocean (Indian Ocean MoU);

  - the Riyadh MoU.

  - The United States Coast Guard maintain the tenth PSC regime.

Paris MoU – Deficiency Codes

- 01 – Certificates and Documentation
- 02 – Structural Condition
- 03 – Water/Weathertight Condition
- 04 – Emergency Systems
- 05 – Radio Communication
- 06 - Cargo Operations Including Equipment
- 07 - Fire Safety
- 08 – Alarms
- 10 - Safety of Navigation

- 11 - Life Saving Appliances
- 12 - Dangerous Goods
- 13 - Propulsion and Auxiliary Machinery
- 14 - Pollution Prevention
- 15 – ISM
- 16 - ISPS
- 18 - MLC, 2006
- 99 – Other

Paris MoU – Deficiency Codes (Related to Ballast)

01 – Certificates and Documentation

    01136 Ballast Water Management Certificate

02 – Structural Condition

    02107 Ballast, Fuel and Other Tanks

    02134 Loading/Ballast Condition

14 - Pollution Prevention

    141 - Pollution Prevention - MARPOL Annex I

        14103 Segregation of Oil and Water Ballast

    148 - Pollution Prevention – Ballast Water

        14801 Ballast Water Management Plan

        14802 Ballast Water Record Book

        14803 Construction Dates Applicable for BWM

        14804 Ballast Water Exchange

        14805 Sediment Removal and Disposal

        14806 Crew Training and Familiarization

        14807 Performance Standardnotmet

        14808 Prototype Ballast Water Treatment

        14809 Conditions for Exemptions

        14810 Ballast Water Discharge Violation in Port

        14811 Ballast Water Management System

        14899 Other BWM

AIM OF THE STUDY

- The aim of the study is to carry out a control on the deficiencies arising from the BWM Convention in Port State Controls of oil and chemical tankers and to propose a model for the assessment of the risk of detention of ships.

- It is thought that the results of the research will contribute to the control policy development processes.
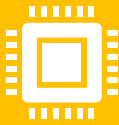
METHODOLOGY

A data set was created by analysing the reports sharing the results of the controls carried out by the Paris Memoranda of Understanding (Paris MoU) between 10.10.2020 - 10.10.2023.

Based on this data set, contributing factors in the detention of oil and chemical tankers, including deficiencies arising from the Ballast Water Management Convention, were determined.

A model was generated to predict the risk of ships being detained using machine learning algorithms. Afterwards, the analyses were completed with SPSS modeler 18.0.

Methodological Flowchart

Paris MoU
on Port State Control
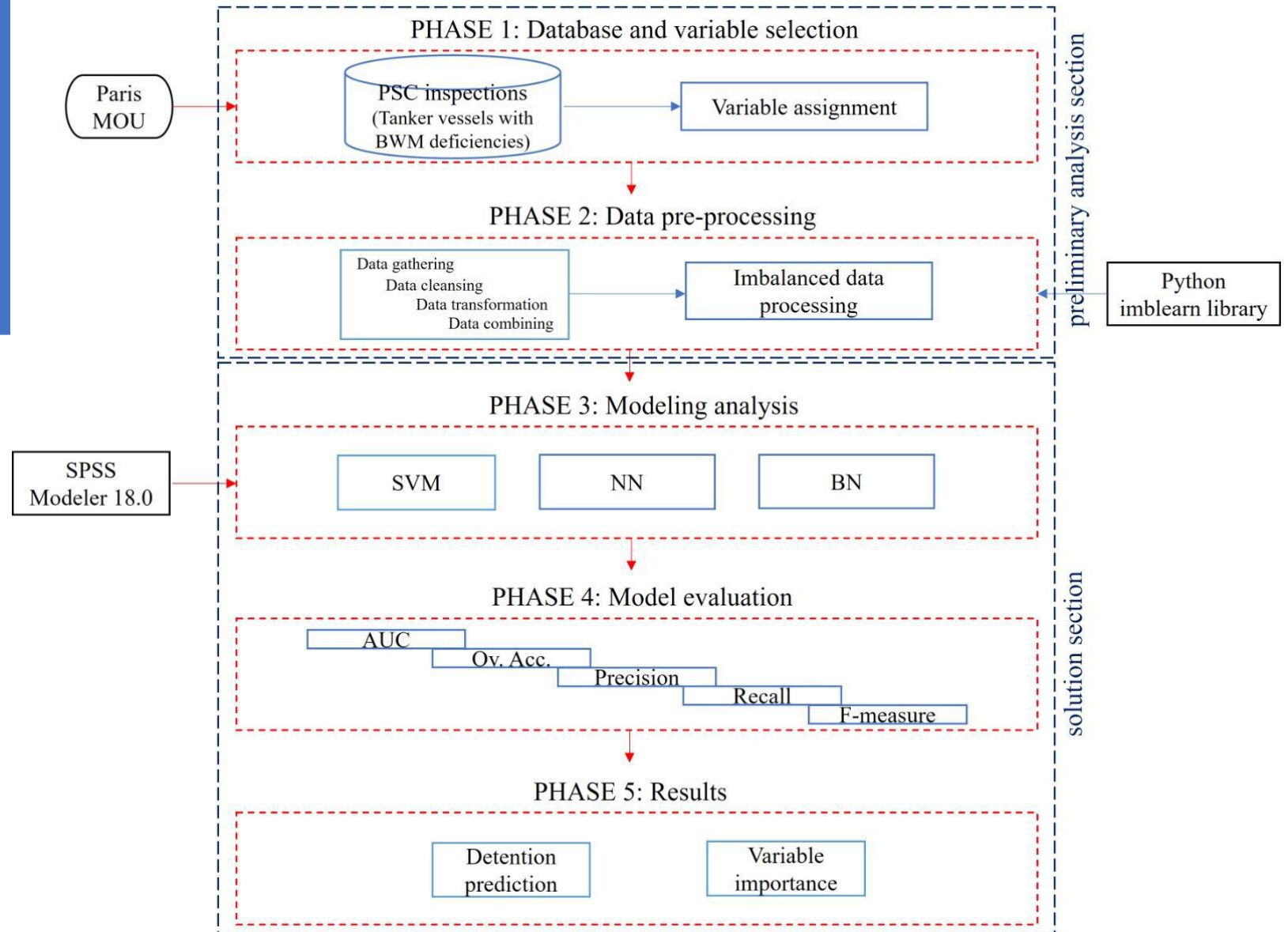
Inspection Database	Statistics & Current Lists	PMoU Procedures	Publications	About Us	Contact

Inspection Search	Current detentions	Current bannings

Inspection Search

Click here for the: ⧉ Company Performance Calculator - pop-up
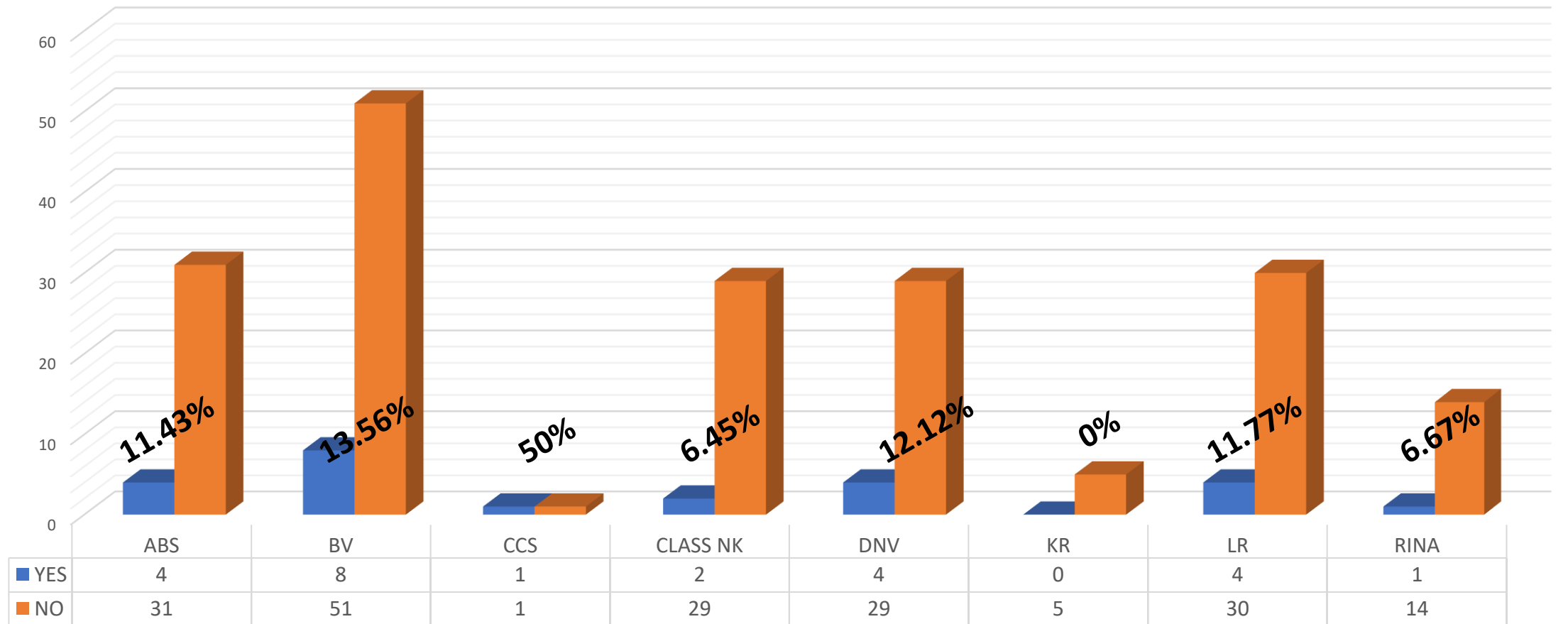Click here for the: ⧉ Ship Risk Calculator - pop-up

Click here for the Press Release about data sharing: 'Press Release about data sharing'

Particulars of the ship as per first visit date of inspection

Search

IMO		ISM Company Number		Type of Inspection	
Name		ISM Company Name		Port State	
Flag		Classification Society		Port of Inspecton	
Ship type		RO Performing Statutory Work		Result	
Gross Tonnage (GT)	To	Period	To	Number of Deficiencies	To
Age	To	Inspection Regime	Port State Control	Deficiency Risk Area	
				Duration of Detention	To

Search   Reset

NUMBER OF DETENTION ACCORDING TO CLASS SOCIETIES

	ABS	BV	CCS	CLASS NK	DNV	KR	LR	RINA
YES	4	8	1	2	4	0	4	1
NO	31	51	1	29	29	5	30	14

Chart percentages: ABS 11.43%, BV 13.56%, CCS 50%, CLASS NK 6.45%, DNV 12.12%, KR 0%, LR 11.77%, RINA 6.67%
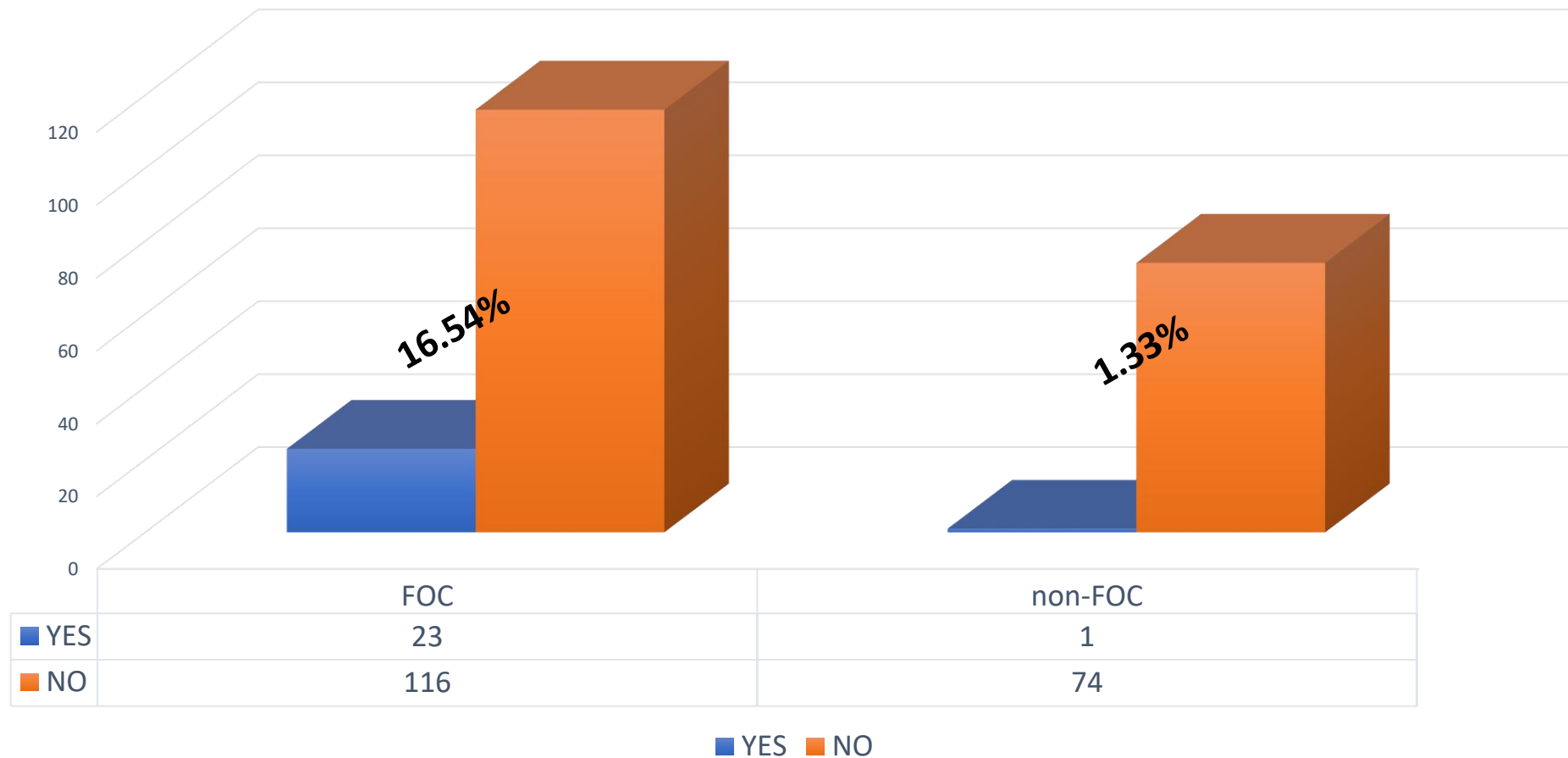
Legend: ■ YES ■ NO

*ABS: American Bureau of Shipping
*DNV: Det Norske Veritas
*BV: Bureau Veritas
*KR: Korean Register of Shipping
*CCS: China Classification Society
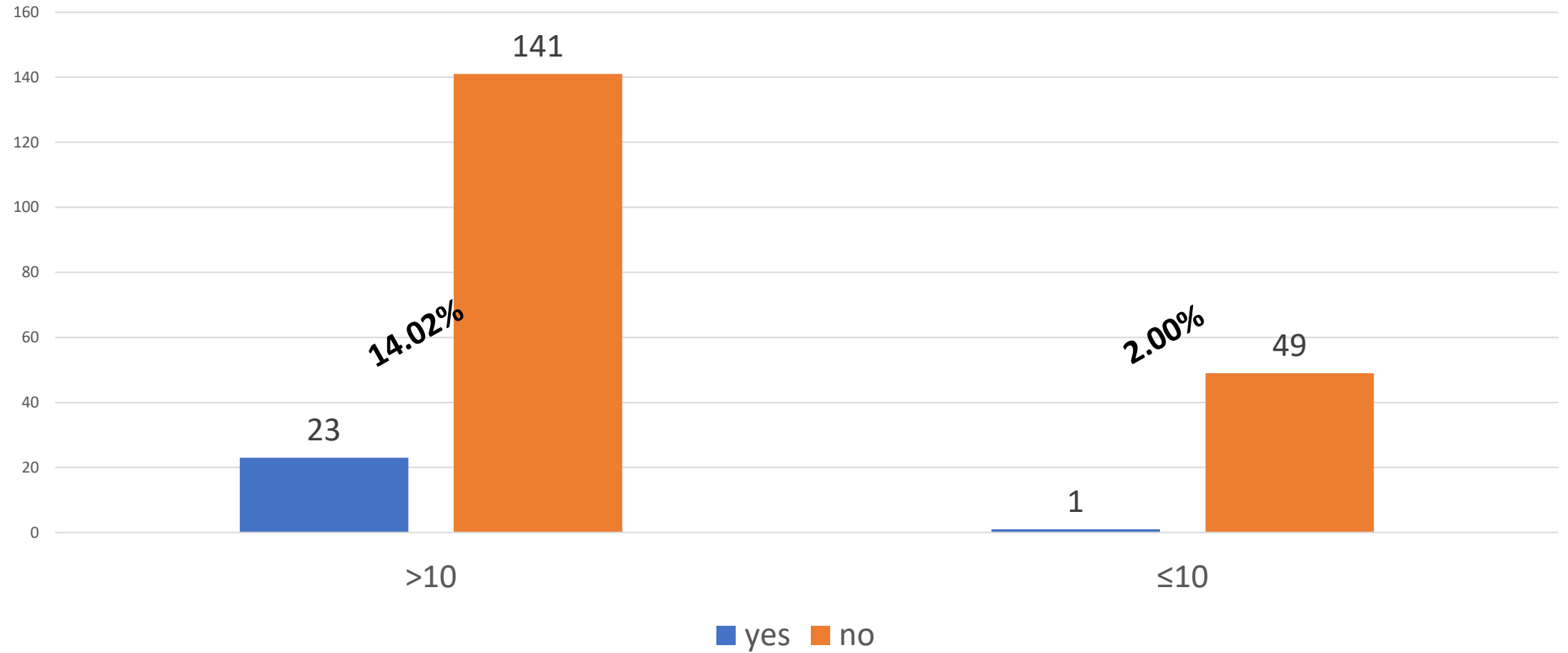*LR: Lloyd's Register
*ClassNK: Nippon Kaija Kyokai
*RINA: Registro Italiano Navale

NUMBER OF DETENTION ACCORDING TO FLAG TYPE

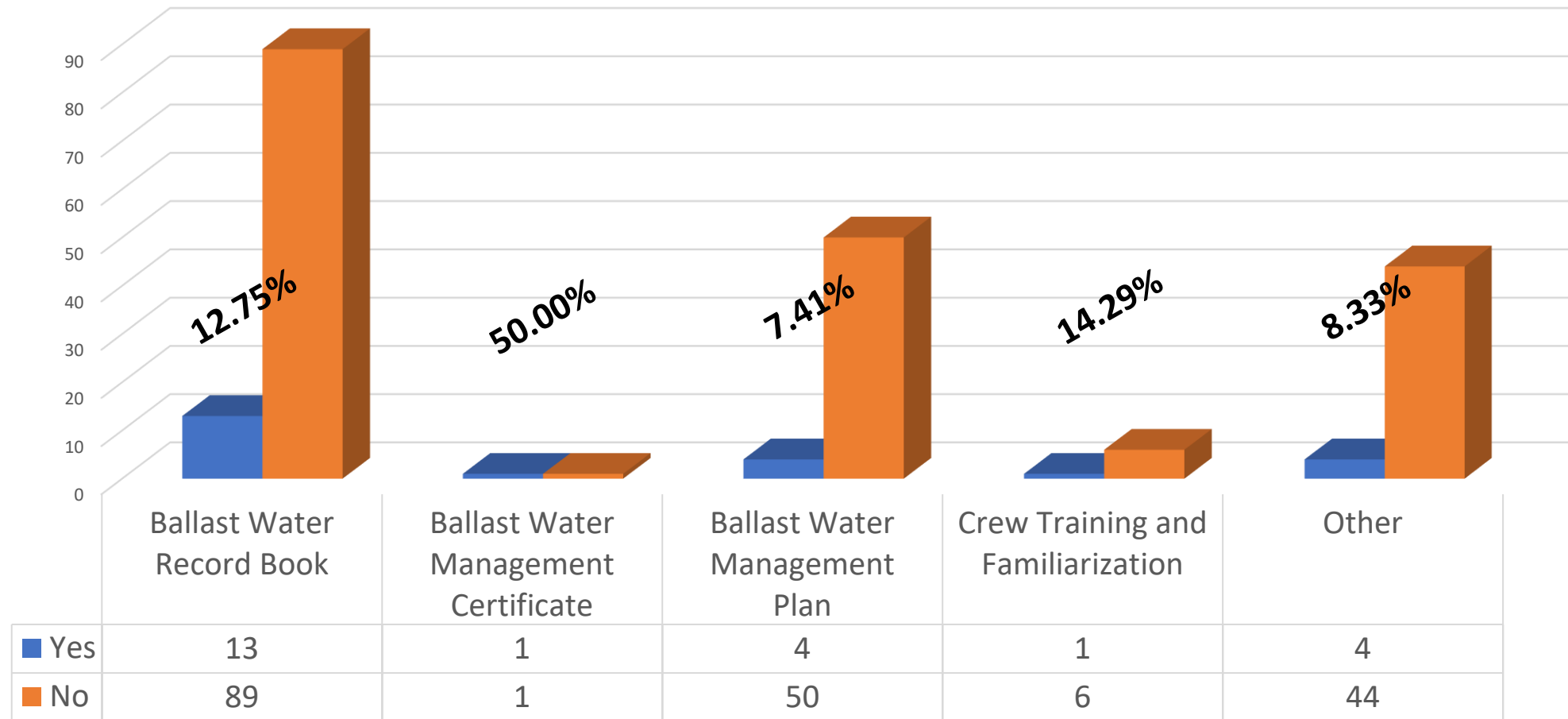|	FOC	non-FOC
YES	23	1
NO	116	74

Legend: ■ YES ■ NO

*FOC: Flag of Convenience (Liberia, Malta, Bahamas, Antigua and Barbuda, Cayman Islands, Panama, Vanuatu, Marshall Islands,...etc. Note: According to ITF)

NUMBER OF DETENTION ACCORDING TO AGE

NUMBER OF DETENTION ACCORDING TO DEFECTIVE ITEM

	Ballast Water Record Book	Ballast Water Management Certificate	Ballast Water Management Plan	Crew Training and Familiarization	Other
Yes	13	1	4	1	4
No	89	1	50	6	44

Balanced Data Processing

- Imbalanced data were balanced using Python Imblearn Library.
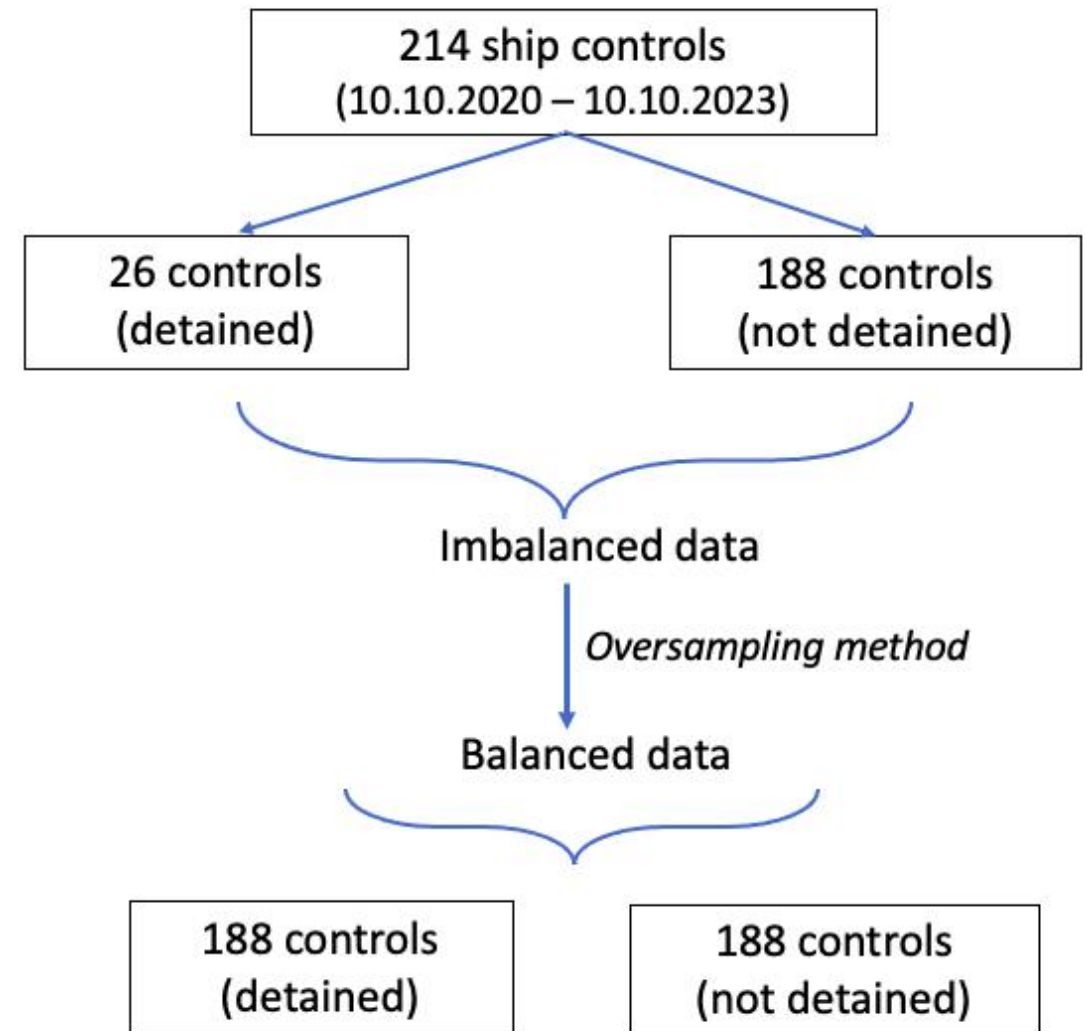
Model Performance Comparison with Balanced Data

	SVM with balanced data	NN with balanced data	BN with balanced data
Accuracy	0.984	0.968	0.960
Precision	0.967	0.951	0.919
Recall	1.000	1.000	1.000
F1-score	0.983	0.975	0.957

*SVM: Support Vector Machine; *NN: Neural Network; *BN: Bayesian Network

Model Performance for SVM

	SVM with imbalanced data	SVM with balanced data
Accuracy	0.927	0.984
Precision	0.970	0.967
Recall	0.970	1.000
F1-score	0.970	0.983

Performance Calculator For Class, Flag and Company

Company inspection history from the last 36 months

How many PSC inspections has the fleet undergone in the Paris MoU region?

In how many detentions have these inspections resulted?

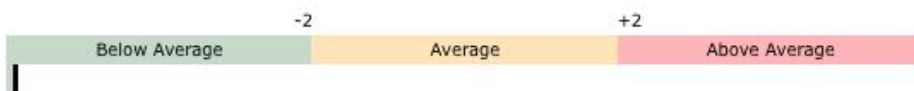How many Non ISM deficiencies have been recorded during these inspections?

How many ISM deficiencies have been recorded during these inspections?

Has a refusal of access order been issued to any ship of the fleet?[1]

Calculate

Company Performance

Detention Index	Deficiency Index	Company Performance
Above Average	Above Average	Very Low
Above Average	Average	
Above Average	Below Average	
Average	Above Average	Low
Below Average	Above Average	
Average	Average	
Average	Below Average	Medium
Below Average	Average	
Below Average	Below Average	High

Company Detention Index

Paris MoU Average Detention Ratio[2] = 3.58 % (detentions per inspections)

-2		+2	
Below Average	Average	Above Average	

Company Detention Ratio = ____ % (detentions per inspection)

Company Deficiency Index

Paris MoU Average Deficiency Ratio[2] = 2.9 % (points per inspections)

-2		+2	
Below Average	Average	Above Average	
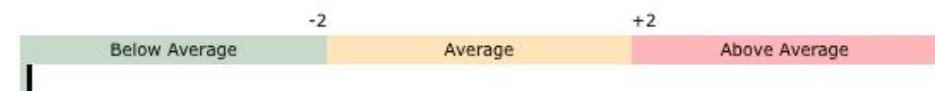
Company Deficiency Ratio = ____ % (points per inspection)

*EMSA/Thetis (European Maritime Safety Agency / The Hybrid European Targeting and Inspection System)

Variable	Description	Node name	Value	Imbalanced data					Balanced data				
				No. of data	Statistic				No. of data	Statistic			
					min	max	mean	SD		min	max	mean	SD
Target													
Detention	Result of detention or not	Detention (yes/no)	Yes; No	214	1	2	1.887	0.316	380	1	2	1.500	0.500
Attributes													
Vessel class	Classification society of the vessel	Class	ABS; BV; DNV; RINA; CCS; ClassNK; LR; KR	214	1	8	2.906	2.323	380	1	8	3.718	2.267
Vessel class performance	Performance of the classification society	Class_Performance	very low; low; medium	214	1	3	1.771	0.698	380	1	3	1.750	0.668
Vessel age	Age of the vessel	Age	(≤10); (>10)	214	1	2	1.766	0.424	380	1	2	1.860	0.346
Vessel size	Classification by GT	Size	(<15k); (15k-20k); (20k-50k); (50k-100k); (>100k)	214	1	5	2.102	1.121	380	1	5	2.076	1.095
Vessel flag	Flag flown by the vessl	Flag	FOC; nonFOC	214	1	2	1.350	0.478	380	1	2	1.221	0.415
Vessel flag performance	Performance of the flag	Flag_Performance	very low; low; medium	214	1	3	1.439	0.584	380	1	3	1.247	0.489
Owner performance	Performance of the owner	Owner_Performance	very low; low; medium	214	1	3	2.752	0.530	380	1	3	2.276	0.740
Type of inspection	Inspection type applied to the vesssel	Type_of_Inspection	inital; more detailed	214	1	2	1.864	0.343	380	1	2	1.923	0.265
Number of deficiencies	Deficiency number recorded	Number_of_Defiencies	(<3); (3-5); (6-10); (>10)	214	1	4	2.373	1.105	380	1	4	2.976	1.144
Defective item	The item regarding the deficiency	Defective_Item	BWM certificate; BWM plan; BW record book, crew training and familiarization; other	214	1	5	3.215	1.087	380	1	5	3.316	1.053

Detention Risk

Factor	State	Scenario	Probability
Class	ABS	S1	0.174
	BV	S2	0.353
	CCS	S3	0.042
	ClassNK	S4	0.058
	DNV	S5	0.189
	KR	S6	0.000
	LR	S7	0.163
	RINA	S8	0.021
Class Performance	Very Low	S9	0.526
	Low	S10	0.374
	Medium	S11	0.100
Age	(>10)	S12	0.979
	(≤10)	S13	0.021
Size	(<15k)	S14	0.500
	(15k-20k)	S15	0.000
	(20k-50k)	S16	0.458
	(50k-100k)	S17	0.042
	(>100k)	S18	0.000
Flag	FOC	S19	0.947
	nonFOC	S20	0.053
Flag Performance	Very Low	S21	1.000
	Low	S22	0.000
	Medium	S23	0.000
Owner Performance	Very Low	S24	0.668
	Low	S25	0.332
	Medium	S26	0.000
Type of Inspection	Initial	S27	0.000
	More detailed	S28	1.000
Number of Deficiencies	(<3)	S29	0.000
	(3-5)	S30	0.084
	(6-10)	S31	0.079
	(>10)	S32	0.837
Defective Item	BWM Certificate	S33	0.058
	BWM Plan	S34	0.174
	BW Record Book	S35	0.558
	Crew Training and Familiarization	S36	0.079
	Other	S37	0.132

Predictor Importance

Predictor Importance
Target: Detention (Yes/No)
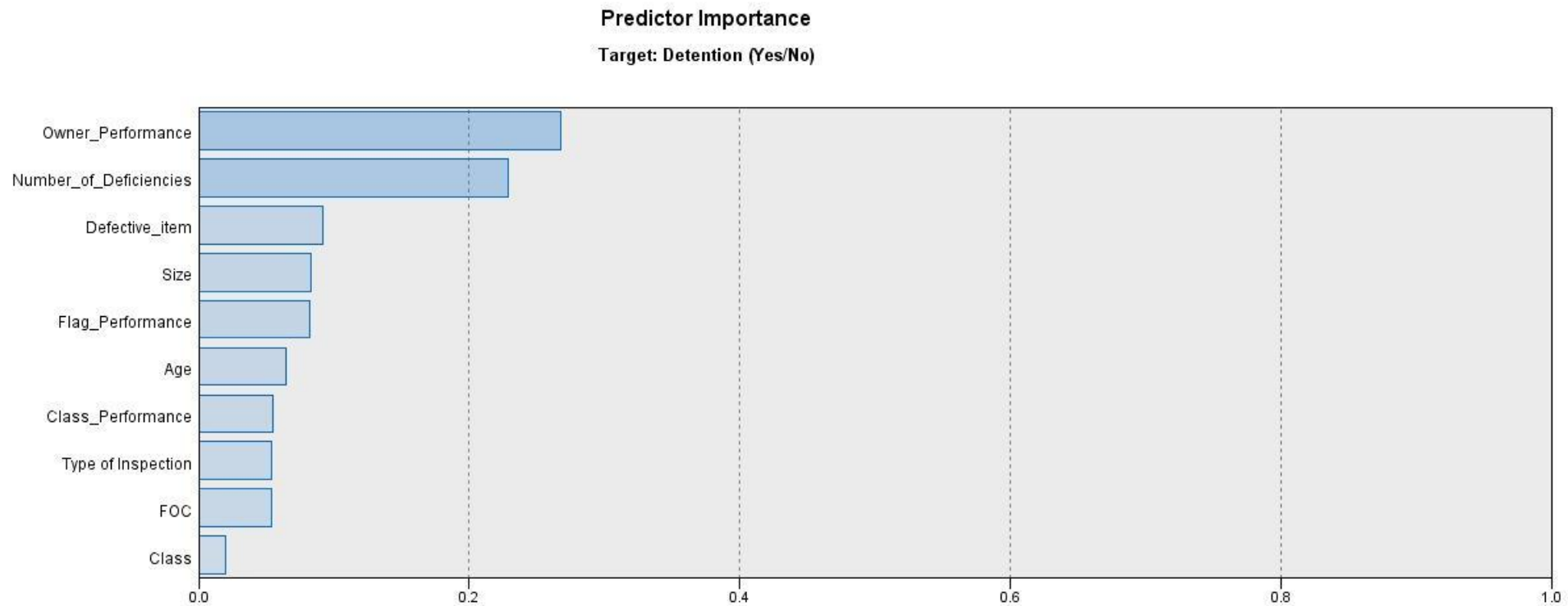
CONCLUSION

- "Owner Performance", "Number Of Deficiencies" and "Defective Item" were the 3 most effective items in the detentions due to deficiencies arising from Ballast Water Management (BWM) Convention in controls of oil and chemical tankers.

- It was observed that the deficiency that has the largest share within the scope of BWM-related deficiencies in the detention of oil and chemical tankers is related to the BW Record Book.

CONCLUSION

- It was observed that the highest detention risk was observed in oil and chemical tankers "<15k" and "20k-50k".

- Over 10 years old oil and chemical tankers were observed to have the highest detention risk.

- The probability of detention was found to be the highest when the number of deficiencies was more than 10.

MAR IAS

FUTURE STUDIES

- The study projection can be extended to 5-year or 10-year periods.

- The study can be carried out on different ship types.

- The study can be carried out using data from different memorandums.

- Study values can be compared with the results of our study by using future eclipses.

- THANK YOU FOR YOUR ATTENTION

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4. IMO Ballast Water Management. (Retrieved October 24, 2023, from https://www.imo.org/en/ourwork/environment/pages/ballastwatermanagement.aspx

5. IMO Implementing the Ballast Water Management Convention (Retrieved October 24, 2023, from https://www.imo.org/en/MediaCentre/HotTopics/Pages/Implementing-the-BWM-Convention.aspx