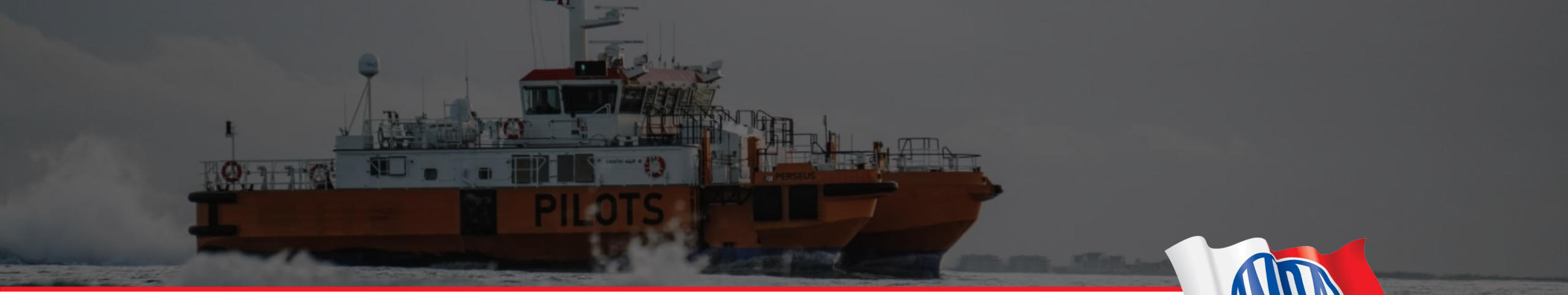

Maritime Pilots and Pilotage

Our commitment to safety, pollution prevention and environmental sustainability

IMO Headquarters, 1 November 2022

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Mr Kitack Lim

IMO Secretary General

Introduction

Captain Simon Pelletier

President, IMPA

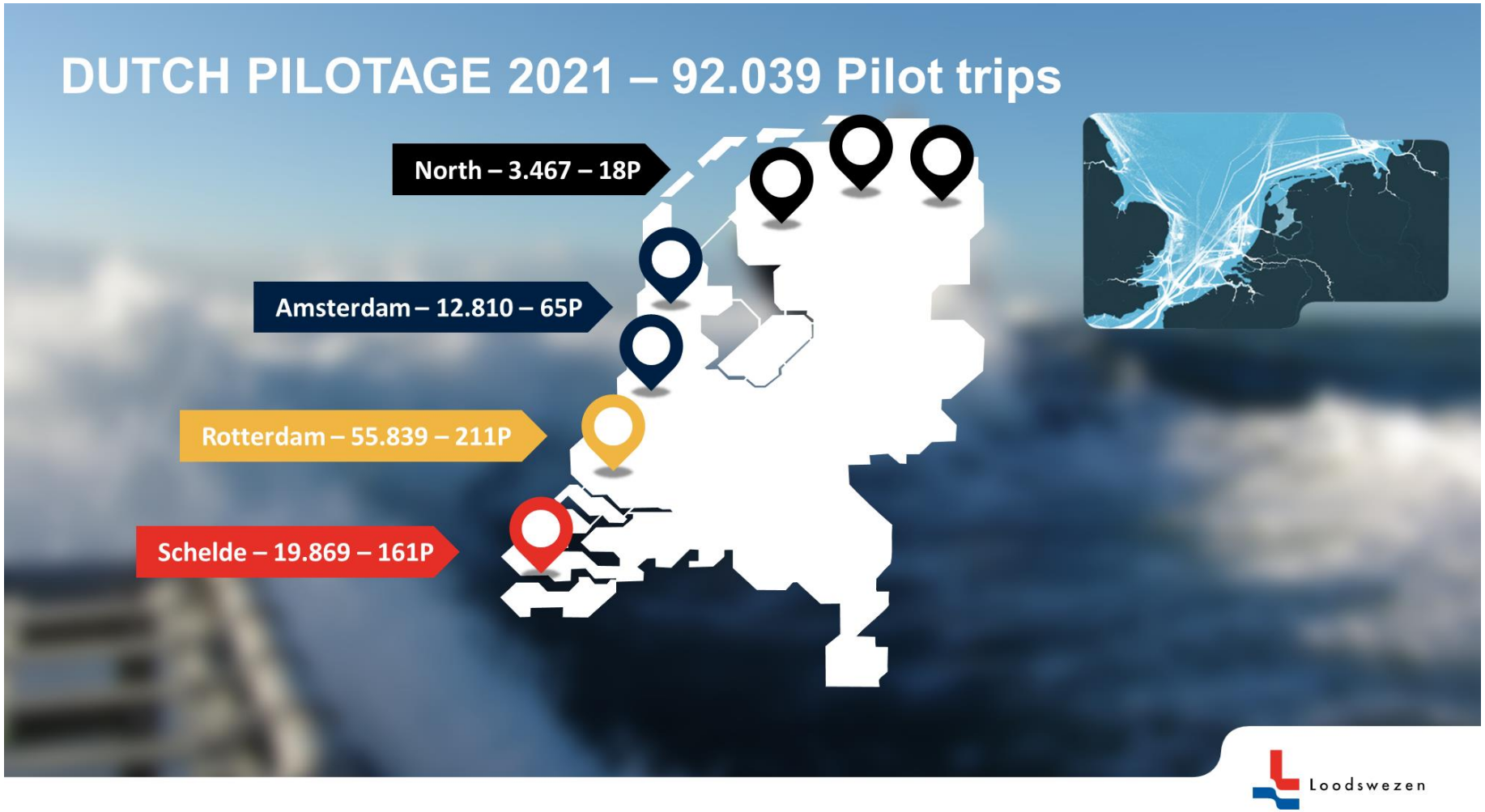
Pilots and Pilotage

Captain Joost Mulder

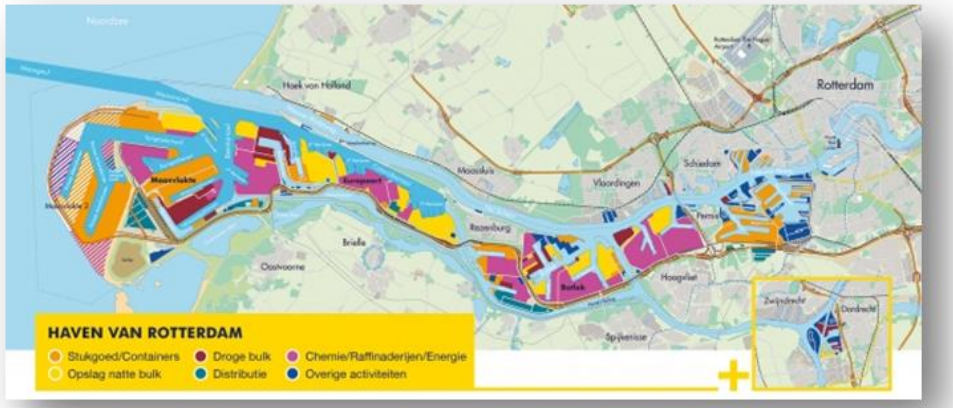
Licensed Pilot

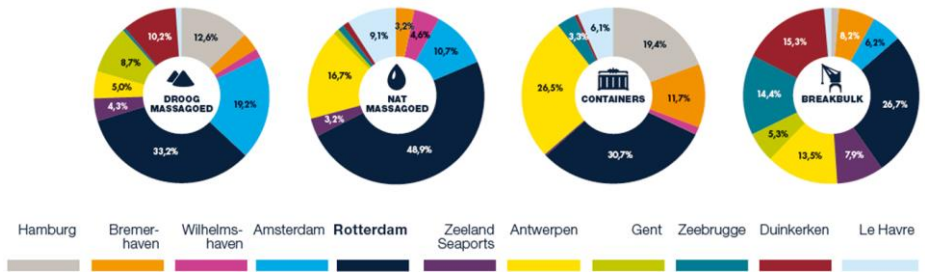
Global trade - shipping

Pilotage in The Netherlands - 2021



The Port of Rotterdam





Why Pilotage?

Safety of **navigation**

Prevention of **pollution**

Efficiency of **maritime trade**

Worldwide: >2 millions acts of pilotage each year

99.95% of acts of pilotage occur without incident

90bn metric tonners of cargo since 2010

Pilotage as a Public service

State Regulation

- Safety
- Quality
- Freedom from commercial pressure

Training and Certification

- Comprehensive syllabus for training and recertification / licensing
- Built on A.960(23)

Operational Practices and Service Enablers

- Portable Pilot Units
- Enabling technologies
- Pilot boats
- Pilot helicopters

Bridge Resource Management	In-depth local knowledge	Shiphandling
Communication	Rules and regulations	Medical fitness
Personal safety and safety equipment	Emergency procedures	Contingency planning

Pillers of Pilotage

Organize	Oversee	Trust
• Regulatory framework • Training and certification • Operational structure	• Administration • Competent Authorities	• Maritime professionals • Committed to safety

Your maritime pilots work for YOU! Advice. Expertise. Service.

Quantifying the Value of Maritime Pilotage

Dr Edwin Kraft

Transport Economics and Management Systems Inc.

Presentation Outline

1. Background
2. Quantifying the Safety Benefits of Pilotage
   a. 2020 Canadian study based on Great Belt, Canadian and US Data

   b. 2022 Work Based on Turkish Straits Data to reassess the Great Belt results
3. Results
4. Conclusions

1. BACKGROUND

- **TEMS developed an initial Cost Benefit Analysis (CBA) of Canadian Marine Pilotage in 2020.**
- **There are few places in the world where a direct comparison of piloted vs. non-piloted shipping in the same waters is available:**
  - **In the 2020 Canadian study, data from the Great Belt of Denmark along with Canadian and US data was used.**
  - **Recently, an additional source of independent comparative data became available from the Turkish Straits.**

2A. 2020 Canadian study based on Great Belt, Canadian and US Data

Two databases: the Great Belt (Denmark) and Puget Sound (USA and Canada) data were used to estimate confidence limits and risk reduction. A safety study of Canadian tankers was used to adjust the Danish results to match Canadian experience.

Steps Followed to develop the safety component of the 2020 CBA

1- Estimate Confidence Interval Range for Grounding Probabilities (Two Studies)*

2- Estimate Pilotage Risk Reduction Ratios

3- To remain as conservative as possible in the analysis, normalize Accident Rates for Agreement with Transport Canada's Oil Tanker Study

4- Calculate the Probability Risk Factors to be Used

* Two studies:

1. The Great Belt of Denmark is one of the few places in the world where there is a high density of shipping but pilotage is not mandatory in restricted waters, because of the Copenhagen Treaty of 1857. This offers a rare opportunity to directly compare the accident rates of piloted versus unpiloted ships operating in the same area. The Great Belt data was limited to grounding probabilities.

2. For assessing the use of tugs by pilots for tankers, the experience in Puget Sound and of the Port of Vancouver was measured.

Geography of the Great Belt of Denmark

The Great Belt offers a broad passageway between the Baltic Sea and North Atlantic ocean. Smaller ships can take either of the routes.

However, the channel depth of Route 1 "The Sound" is limited. Deep draft ships can only take Route 2 via the "Great Belt."

Denmark to IMO, *Consideration of the Reports and Recommendations of the Maritime Safety Committee, The advantages of taking a Pilot*, October 14, 2005.

Data on Grounding Probabilities from the Great Belt (Denmark) was used to Estimate Confidence Intervals and Pilotage Risk Reduction

Safe Shipping in the Baltic Sea, April 24-25, 2009, Gdansk, Poland

The Great Belt Channels are a twisting, ancient riverbed which require complicated maneuvers for deep-draft ships to avoid grounding.

This is the main reason why pilotage is recommended for all vessels exceeding 11 meters draft. (But cannot be made compulsory)

Firstly, Grounding Probabilities Estimated with/without Pilots, in the Great Belt

Clopper-Pearson formulas were used to estimate Confidence intervals on the probabilities of accident occurrences in the Great Belt:

$$\sum_{k=0}^{k} \binom{n}{k} {p_{UB}}^{k} (1 - p_{UB})^{n-k} = \frac{\alpha}{2}$$

$$\sum_{k=x}^{n} \binom{n}{k} {p_{LB}}^{k} (1 - p_{LB})^{n-k} = \frac{\alpha}{2}$$

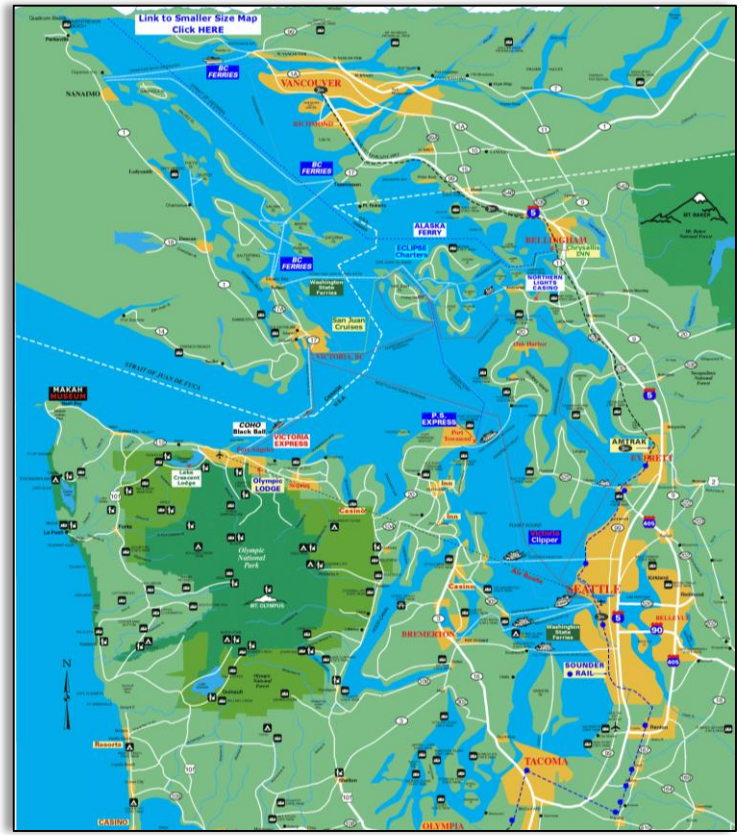
***Without* Pilots (Actual)**:
67 ships, 6.3 groundings *(9.4%)*
95% CI Range = [3.358% to 18.480%]

***With Pilots but no Tugs* (Actual)**:
1,743 ships, 0 groundings
95% CI Range= [0.000% to 0.211%]

The results show that the Confidence Limits don't overlap and are very different for Piloted vs. Non Piloted Ships

Denmark to IMO, *Consideration of the Reports and Recommendations of the Maritime Safety Committee*, *The advantages of taking a Pilot*, October 14, 2005. 6.3 (fractional) groundings was a result of normalizing the two sets of data to cover the same length of time.

Secondly, Tanker Grounding Probabilities with/without Escort Tugs, in Puget Sound



Using the Clopper-Pearson formulas again:

***With Pilots but no Tugs* (Estimated):**
20,000 ships, 28 groundings *(0.14%)*
95% CI Range = [0.093% , 0.202%]

***With* Both Pilots and Tugs (Actual):**
20,000 ships, 0 groundings
95% CI Range = [0.000%, .0180%]

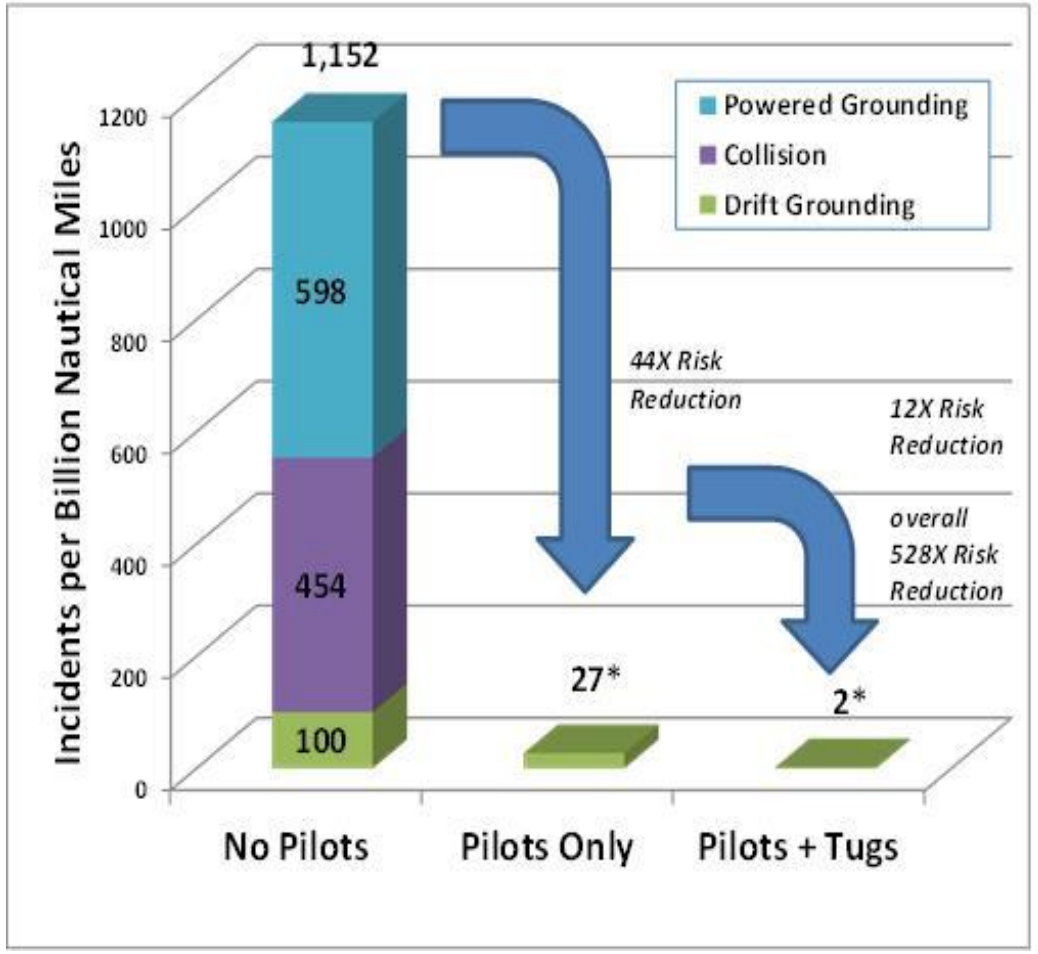
The results show that the Confidence Limits don't overlap and are very different for Ships With vs. Without Escort Tugs

- *Study of Tug Escorts in Puget Sound*, page 93 : http://www.environmental-research.com/erc_reports/ERC_report_6A.pdf

Overall Pilotage Risk Reduction Ratios

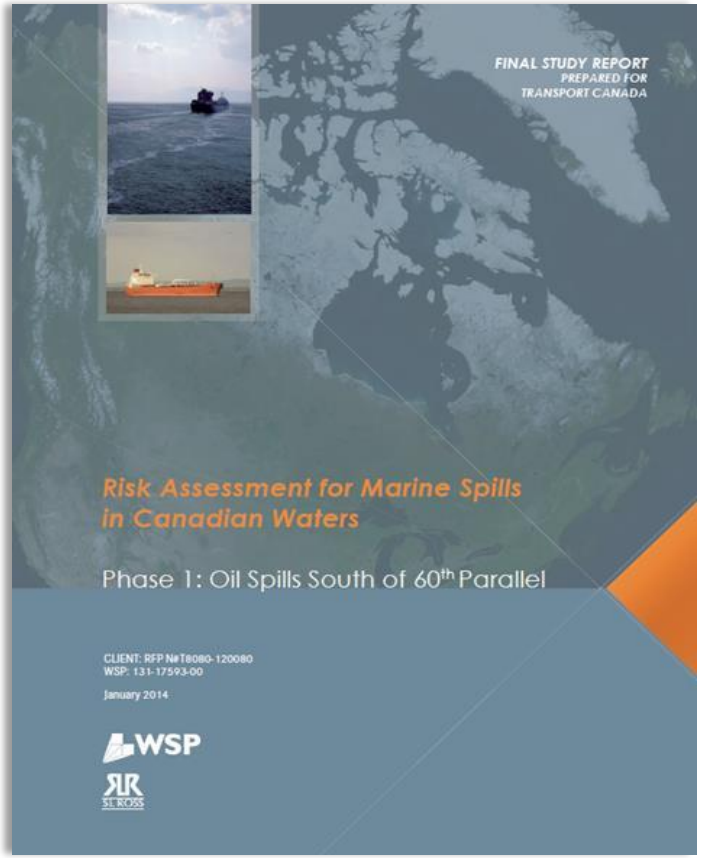
By comparison to International risk factors*, this suggests that:

- **Pilotage alone results in a 44x risk reduction; it practically eliminates Powered Grounding and Collision incidents; and can even prevent around ⅔ of Drift Grounding incidents)**
- **Utilization of tugs results in an additional 12x risk reduction; which almost fully eliminates (98%) Drift Grounding incidents.**
- **Overall risk reduction factor of 528x compared to not having Pilots and Tugs.**



** Source of International Risk Factors: Det Norske Veritas (DNV): the number of accidents per Billion NM sailed, international shipping experience.. Prince Rupert Marine Risk Assessment*, DNV: http://saveourskeenasalmon.org/wp-content/uploads/marine_risk_assessment.pdf

Great Belt Results were Adjusted to Agree with Transport Canada's Oil Tanker Study



This 2014 Transport Canada study* predicts there are going to 0.053 oil spill accidents per year in Canada exceeding 1,000 m^3, or once every 18.9 years.

*** Study used International Data which included US Shipping and Puget Sound**

NORMALIZATION TO TRANSPORT CANADA'S STUDY

The Transport Canada study suggested that the Great Belt results should be reduced by a factor of 10x, because *piloted ships in Canada simply aren't involved in accidents at the high rate that unpiloted vessels were in the Great Belt. This REDUCED the level of safety benefits quantified in the 2020 study by 10x.*

Resulting Risk Probabilities for Vessel Incidents:

1. **No Pilots = 0.3358% . . . Conservative Starting Point**
2. **Pilots Only = 0.0076 % . . . *44x Risk Reduction vs No Pilots***
3. **Pilots and Tugs = 0.000636% . . . *Further 12x Risk Reduction***

RESULT: 0.000636% * 10,227 annual tanker pilotage assignments = 0.065 accidents/year

- ***Overall Risk Reduction 44 x 12 = 528x for Pilots with Tugs***
- ***An important question is whether or not the 10X factor is correct. Additional data is needed to verify this.***

2B. 2022 Work Based on Turkish Straits Data to Reassess the Great Belt Results

This section presents a 2022 IMPA assessment of data from the Turkish Straits that further investigates the impact pilotage has on risk reduction.

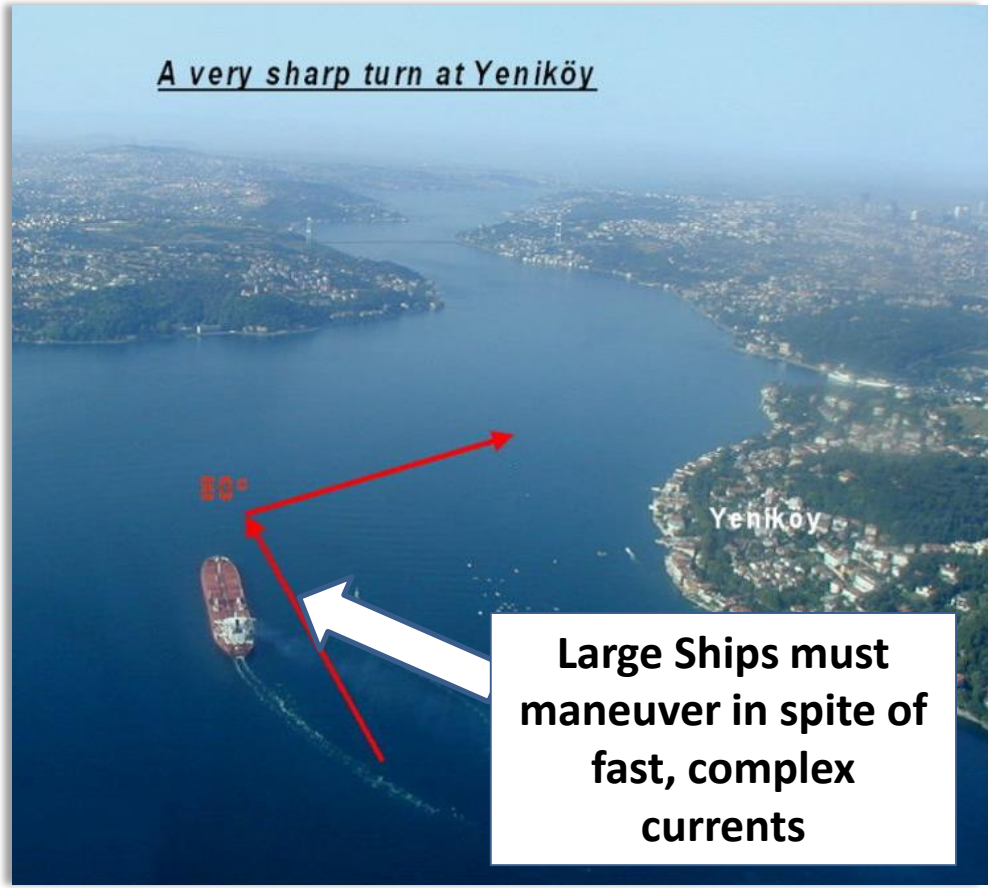
GEOGRAPHY OF THE TURKISH STRAITS

The Turkish Straits consist of two narrow passages: the Canakkale and Istanbul Straits, connected by the Sea of Marmara.

Of these, the Istanbul passage is the more challenging of the two, and is the focus of our analysis.

Source: TAŸAN, *Ship Transitions from Turkish Straits and Analysis of Transition Times,* Master's Thesis, Exhibit 2.1, 2019

TURKISH STRAITS: NAVIGATIONAL CHALLENGES

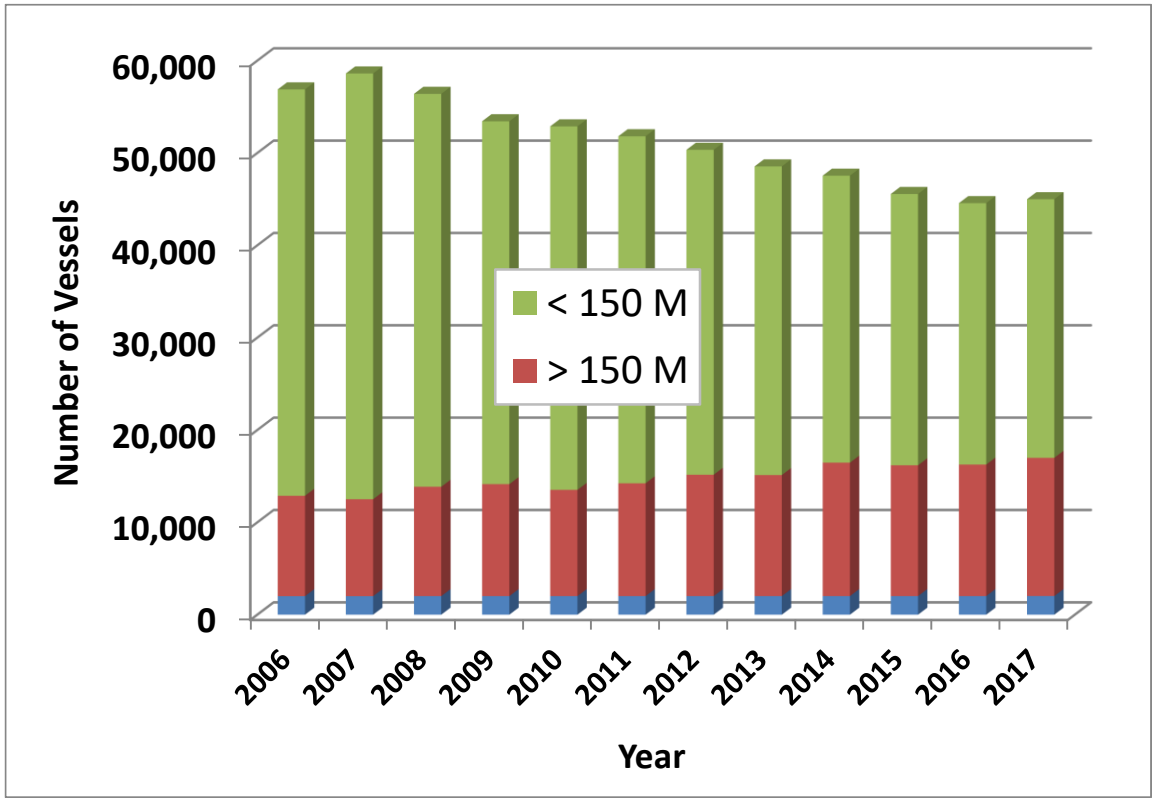


The straits are very sinuous, often narrow, and experience strong and complex currents. The surface current can reach 6 to 8 knots. Furthermore, there are counter-currents, eddy currents and the current of ORKOZ.

The is one of the reasons why IMO strongly recommends using pilots, and also an escort tug for large ships or those carrying hazardous commodities.

The Turkish Straits Vessel Traffic Service (TSVTS),
https://afcan.org/dossiers_techniques/tsvts_gb.html

Total Transits have been Declining, but there are more Large Ships

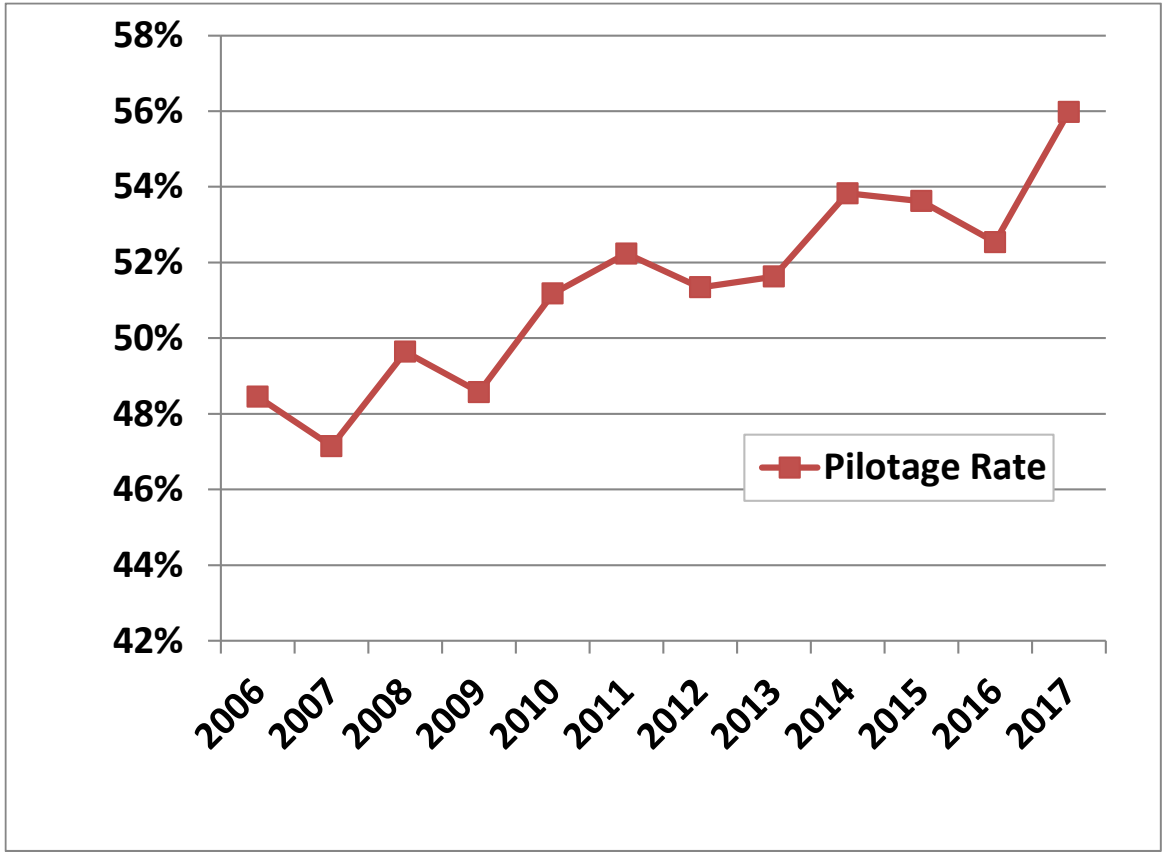


Small Ships have been declining while the numbers of large ships has been increasing.

*** Source: TAÿAN, *Ship Transitions from Turkish Straits and Analysis of Transition Times,* Master's Thesis, Table 2.3, 2019**

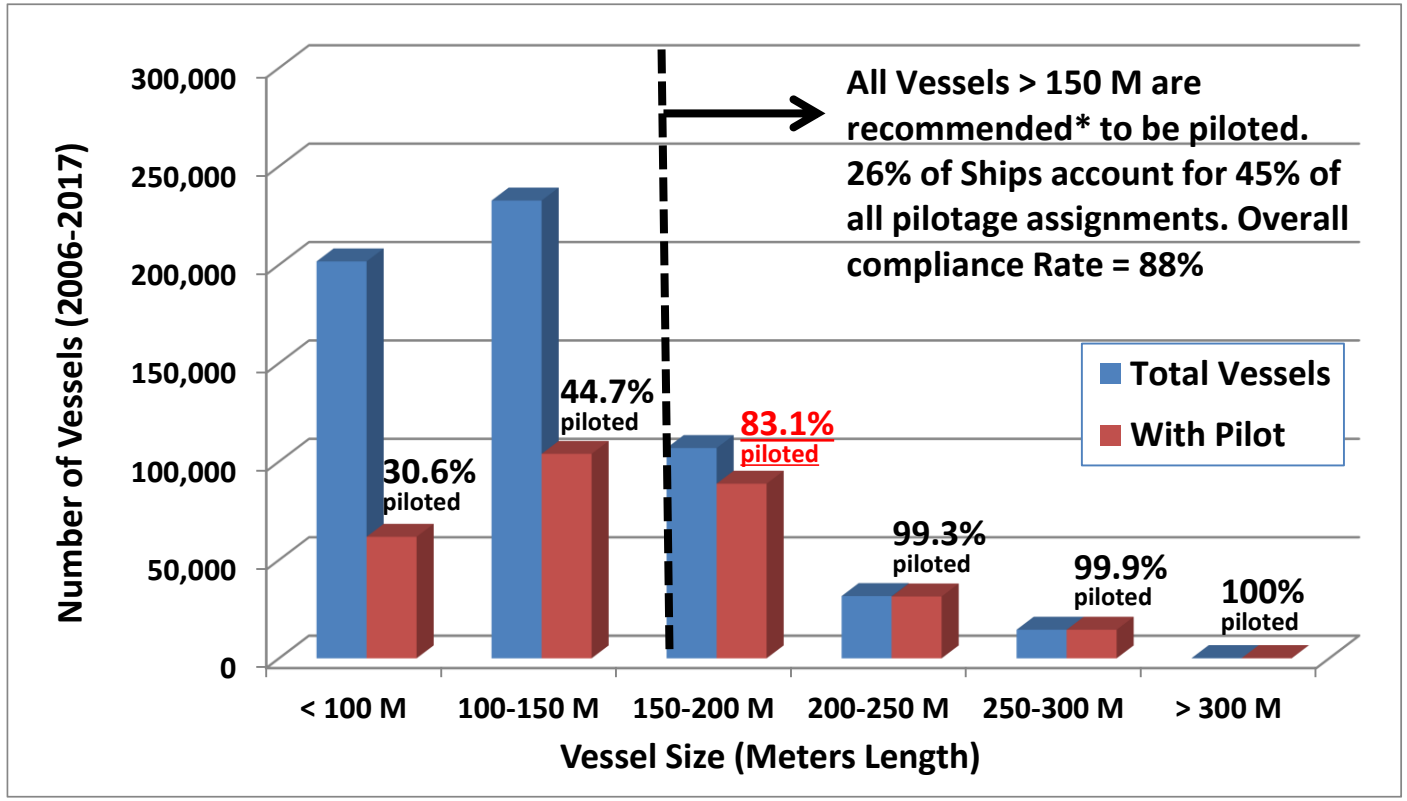
Use of Pilots has been Rising Because of the Increase in Ship Size

- ***However, total accidents have been declining.***
- ***Increased use of Pilotage has mitigated the additional navigational risk associated with larger ships.***



Source: TAÿAN, *Ship Transitions from Turkish Straits and Analysis of Transition Times*, Master's Thesis, Table 2.3, 2019

USE OF PILOTS BY VESSEL SIZE, 2006-2017



* Cannot be *required* to take a pilot. Large vessels do tend to take pilots, whereas small vessels tend not to take pilots. Of particular concern is the size category 150-200 meters where only 83.1% of ships have been taking a pilot. (Source: TAÿAN, *Ship Transitions from Turkish Straits and Analysis of Transition Times,* Master's Thesis, Table 2.3, 2019)

ACCIDENTS WITH/WITHOUT PILOT, 2004-2019

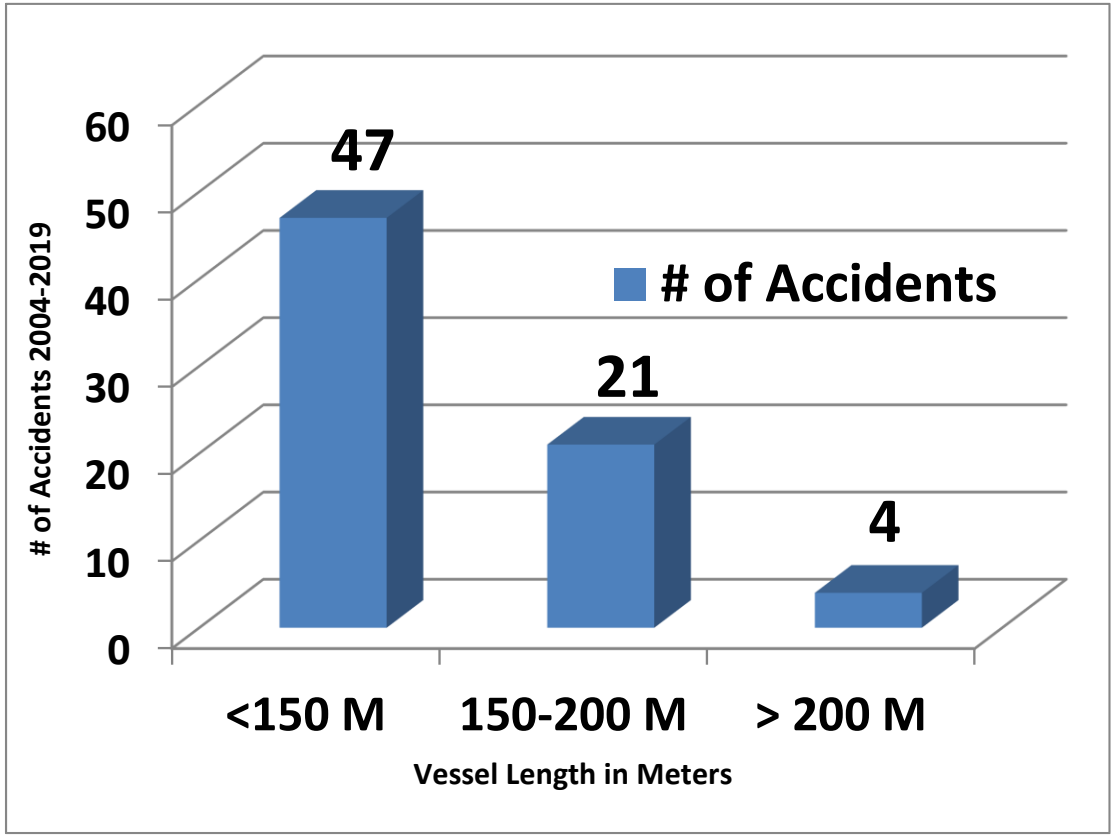
Type of Accidents	Total Number of Accidents	PILOT	
		With Pilot	Without Pilot
Collision 1 "fixed object"	205	13	192
Collision 2 "with vessel"	50	3	47
Grounding	73	9	64
Fire	18	1	17
Sink	9	0	9
TOTAL	355	26	329

The Turkish accident data includes Collisions, which were absent from the Great Belt data that only focused on groundings.

This was an important omission because collisions represent 70% of the accidents in the Turkish straits.

(Source: GURSOY, *Analysis of Ships' Accidents and Defects at Istanbul Strait*, Master's Thesis, Table 4.9, 2021)

Distribution of Accidents by Vessel Size, 2004-2019



Based on a review of all accidents with classification data available, Gursoy gives a relative proportion of accidents by vessel size.

Ships > 200 M are the piloted ones -- not having many accidents!

(Source: GURSOY, *Analysis of Ships' Accidents and Defects at Istanbul Strait,* Table 4.13, Master's Thesis, 2021)

Probabilities were Calculated by Scaling Pilot/Non Pilot and Accidents by Ship Size

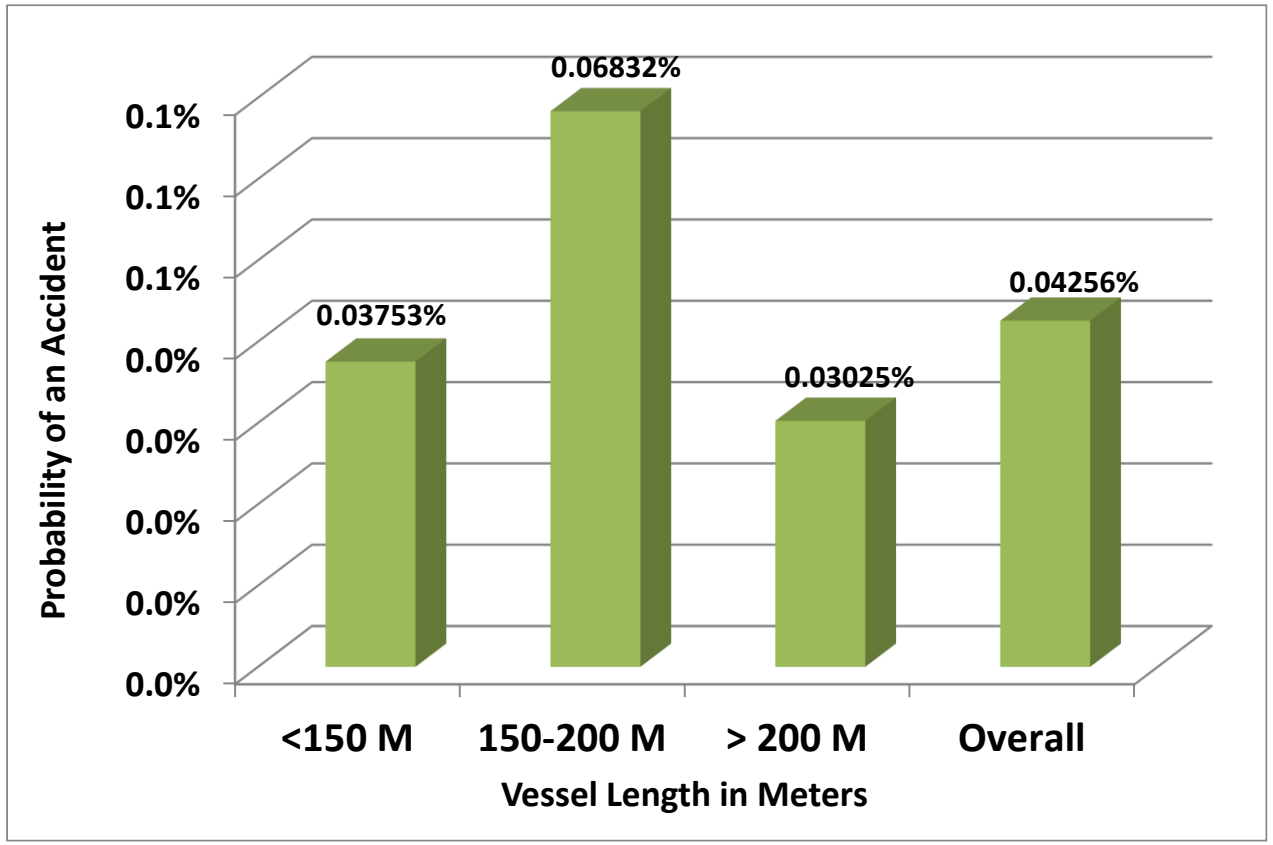
Number of Vessels (2006-2017)				
	< 150 M	150-200 M	> 200 M	TOTAL
Non Piloted	268,685	18,108	240	287,033
Piloted	165,627	88,737	46,041	300,405
TOTAL	434,312	106,845	46,281	587,438

Accident Probabilities (2006-2017)				
	< 150 M	150-200 M	> 200 M	OVERALL
Non Piloted	0.06004%	0.37222%	1.37207%	0.08083%
Piloted	0.00102%	0.00631%	0.02326%	0.00599%
TOTAL	0.03753%	0.06832%	0.03025%	0.04256%

Calculated Results				
	< 150 M	150-200 M	> 200 M	OVERALL
Non Piloted/Piloted:	59.0	59.0	59.0	13.5
Navigational Risk Factor:	**1.0**	6.2	**22.9**	

- **Risk Factors rise with vessel size.**
- **The data shows that Pilotage reduces accident risks by 59X, effectively mitigating the increase in risks associated with larger ships.**
- **A large piloted ship > 200 M is 2.6 X less likely to have an accident than an unpiloted small ship of < 150 M.**

Accident Risk by Ship Size



The overall accident risk is the worst for ships in the 150-200 M category. This is a direct result of the lack of pilot utilization as previously noted.

3. RESULTS

- **Analysis of the data from the Turkish straits shows a Risk Reduction Ratio of 59X for pilotage – which exceeds the 44X of the 2020 study based on Great Belt, Canadian and US data.**
- **The Overall Accident Rate for Piloted Ships in the Turkish Straits data is 0.00599%. This is very close to the 0.00636% found from the Great Belt data.**
- **However, a 10X factor used in the 2020 Canadian study reduced the safety benefits by 10x. This reduction may have been overly conservative.**
- **The new analysis suggests that the original Great Belt findings are even more applicable than originally thought.**

4. CONCLUSIONS

- **Data from the Turkish straits indicate that an accurate quantification of the Risk Factor reduction associated with pilotage is higher than the 44x identified in the Canadian 2020 study, possibly reaching 59x.**
  - **This is likely due to inclusion of collision risk and ship size factors in the Turkish analysis, which were not included in the Great Belt analysis.**
- **This means the safety benefits of pilotage identified in the 2020 study are likely higher than what was established.**
- **In turn, this means that the ratio between the safety benefits of pilotage vs its costs was also likely underestimated.**

Cost Benefit Results from the 2020 Canadian Pilotage Study

Safety Benefits were the Largest single component of the overall CBA results in the 2020 Study. This work with the Turkish Strait data has suggested that they might have been considerably underestimated.

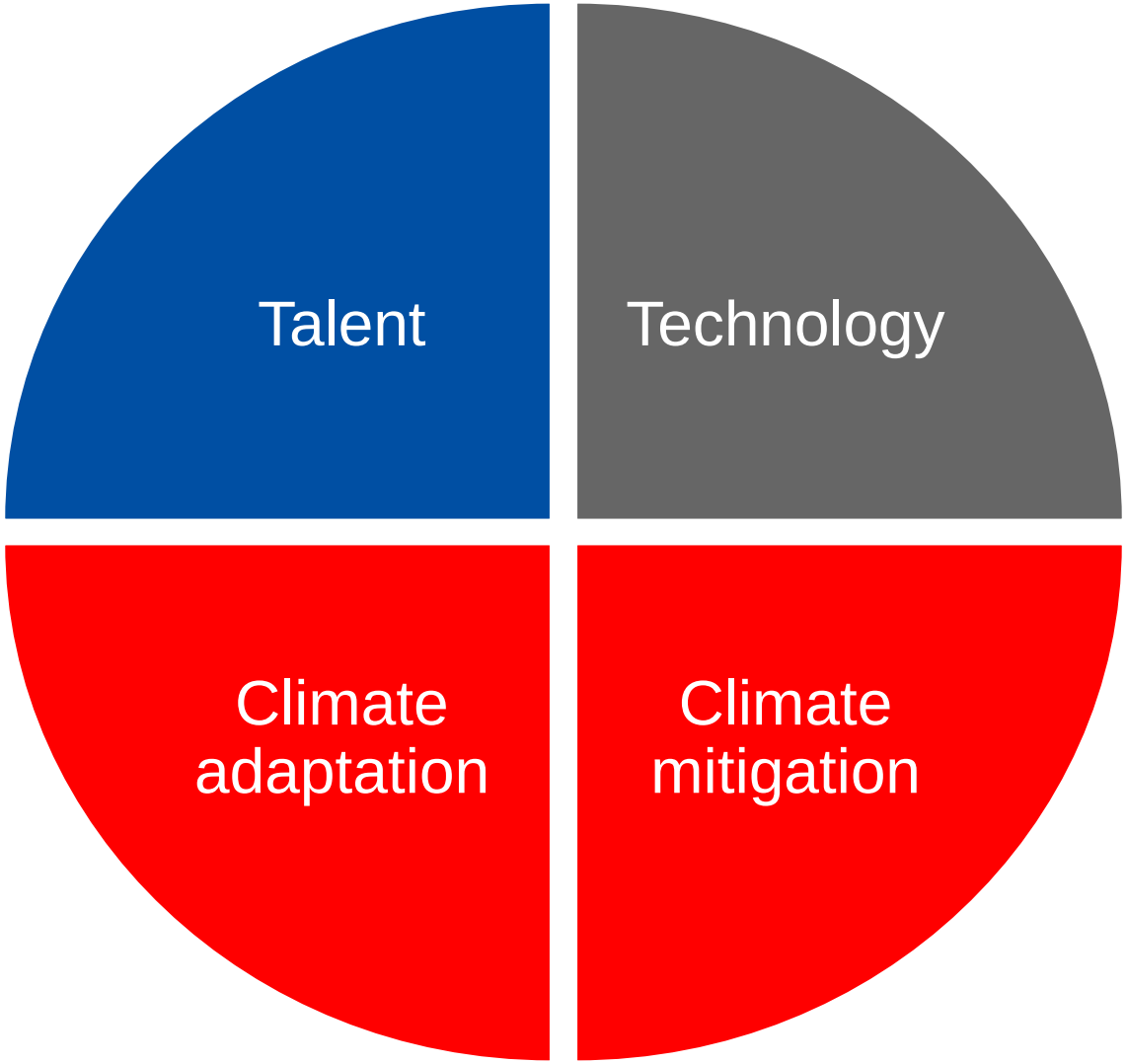
District	Pilots- Expected Case			
	Reduced Cost of Accidents (CDN $Mil)	Selected Productivity Benefits (CDN $Mil)	Total Benefit (CDN $Mil)	Pilotage Cost (CDN $Mil)
Laurentian	$3,410.08	$45.93	$3,456.02	$102.19
Pacific	$872.99	$62.14	$935.13	$92.92
Atlantic	$1,434.40	$684.26	$2,118.66	$25.29
Lakes	$1,270.01	$48.12	$1,318.13	$35.63
TOTAL	$6,987.49	$840.45	$7,827.94	$256.03
BC Ratio	**30.57**			

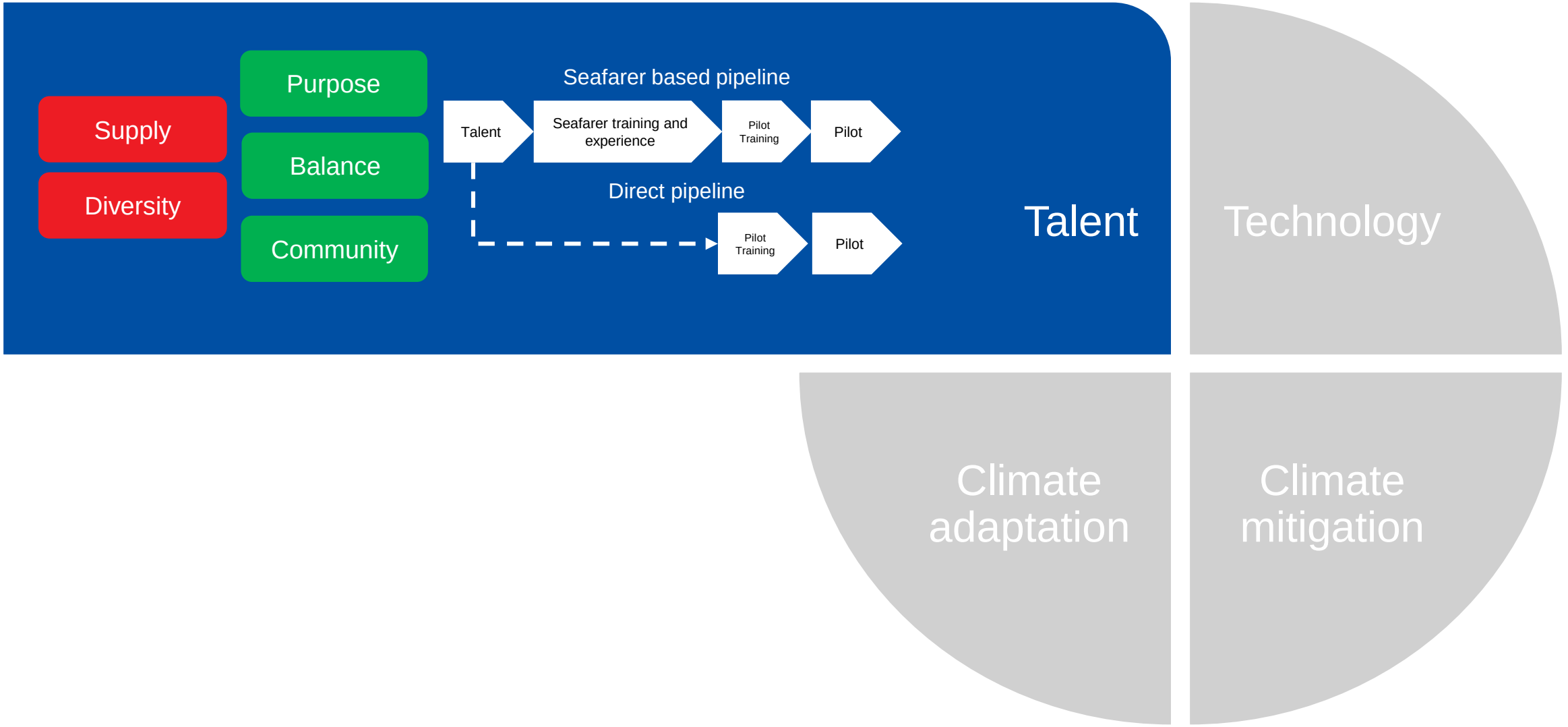
The Future

Matthew Williams

Deputy Secretary General, IMPA

Introduction




Supply
Diversity
Purpose
Balance
Community
Seafarer based pipeline
Talent
Seafarer training and experience
Pilot Training
Pilot
Direct pipeline
Pilot Training
Pilot
Talent
Technology
Climate adaptation
Climate mitigation

Talent

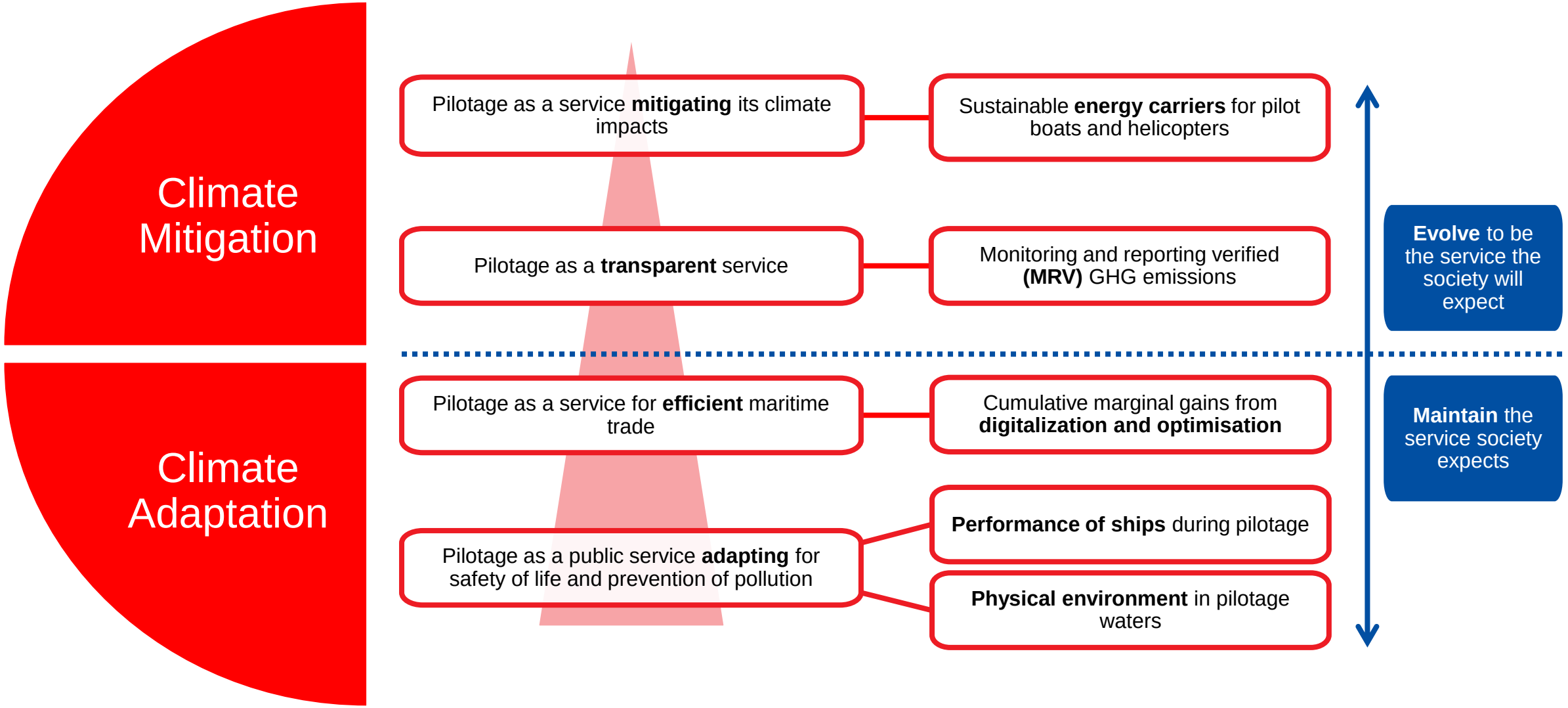
Technology

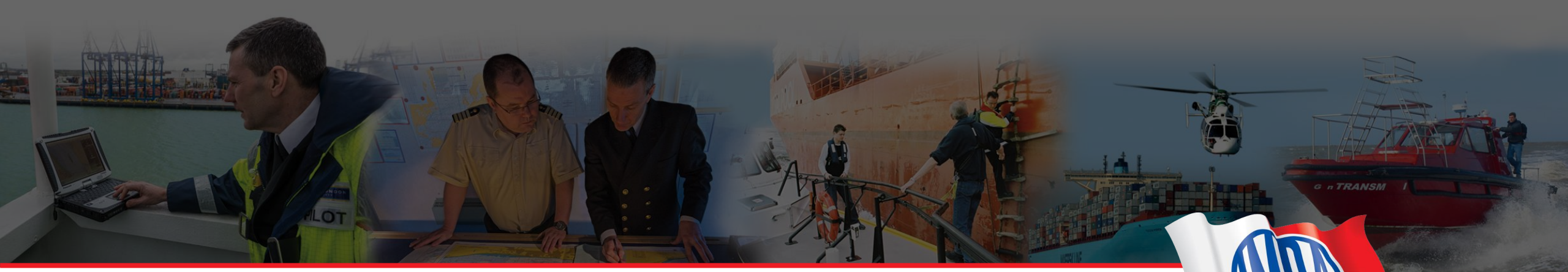
= Likelihood x Impact

= Likelihood x Impact

Climate adaptation

Climate mitigation


Climate Mitigation
Climate Adaptation
Pilotage as a service **mitigating** its climate impacts
Sustainable **energy carriers** for pilot boats and helicopters
Pilotage as a **transparent** service
Monitoring and reporting verified **(MRV)** GHG emissions
Pilotage as a service for **efficient** maritime trade
Cumulative marginal gains from **digitalization and optimisation**
Pilotage as a public service **adapting** for safety of life and prevention of pollution
Performance of ships during pilotage
Physical environment in pilotage waters
Evolve to be the service the society will expect
Maintain the service society expects



Thank you

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