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Understanding Ship Operations

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The results presented are from the Conference paper:

University of Strathclyde Engineering

Understanding ship operating profiles with an aim to improve energy efficient ship operations

Conference: Shipping in Changing Climates 2014

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Introduction

- Energy efficiency has always been an important factor to minimise ship operational costs, **YET** it has not always been a focus during design and operation

Over the past years there has been increased pressure to reduce anthropogenic carbon emissions with an aim to mitigate Climate Change.

This has coincided with the global financial crisis

1st January 2013 maritime energy efficiency regulations entered into force

- The Energy Efficiency Design Index, EEDI,
- The Ship Energy Efficiency Management Plan, SEEMP

Case Data

The data collected and used for the analysis consists of:

- '**noon reports**'
  - recorded each day at noon whilst full away sailing at sea

- '**port reports**' and **other reports**
  - recorded on approach to port, on arrival, daily in port, on departure

Example fields include:

» Report date time
» Report type
» Voyage type
» Speed
» Main engine heavy fuel oil consumption
» Auxiliary engine heavy fuel oil consumption
» Main engine marine diesel oil consumption
» Auxiliary engine marine diesel oil consumption
» Mean draft

Labelling of fields varies within reports

Case Data
Notes about the data fields

- Mean draft values were only contained in a few reports.
  - In some cases it was possible to obtain and correlate the draft data from another data sources, but this was not possible for all of the case ships
- There were differences in the data sets for each ship, even for the same companies
- Many records contained missing values
- Some zero values could be considered unreasonable
- Some values were unreasonable
  - Including human error: imprecise observations, process and/or transcription error

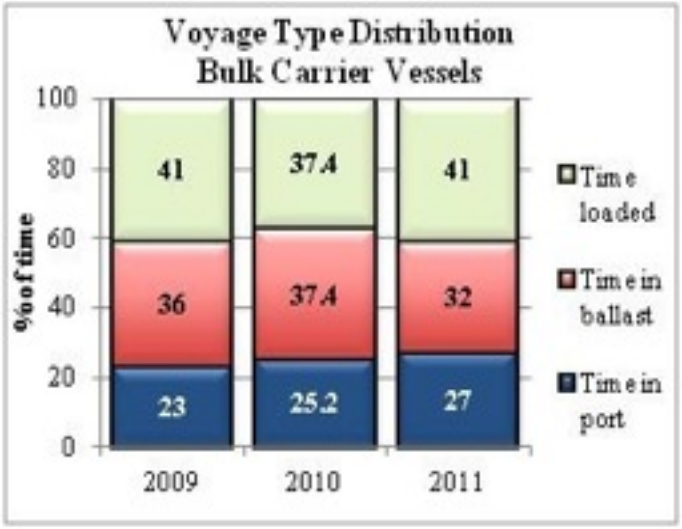
Case Data

The record sets for each ship were obtained from four different companies:

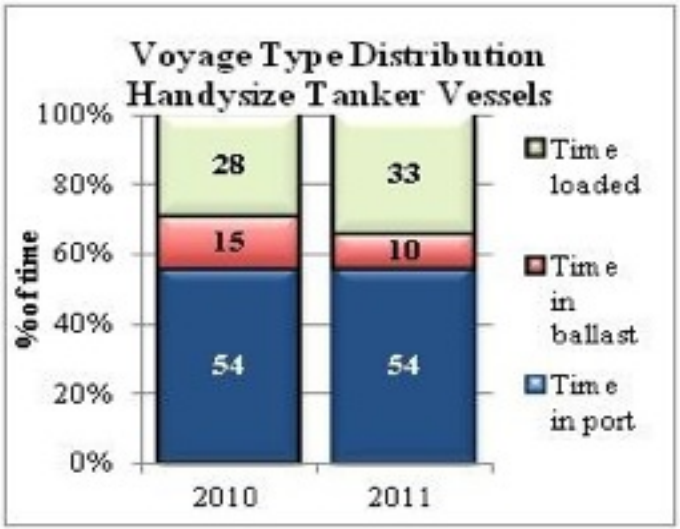
- 4 Bulk Carriers
- 1 Handysize tanker
- 4 Aframax tankers
- 5 Suezmax tankers
- 2 Post Panamax Container ships
- 4 Post Panamax plus Container ships

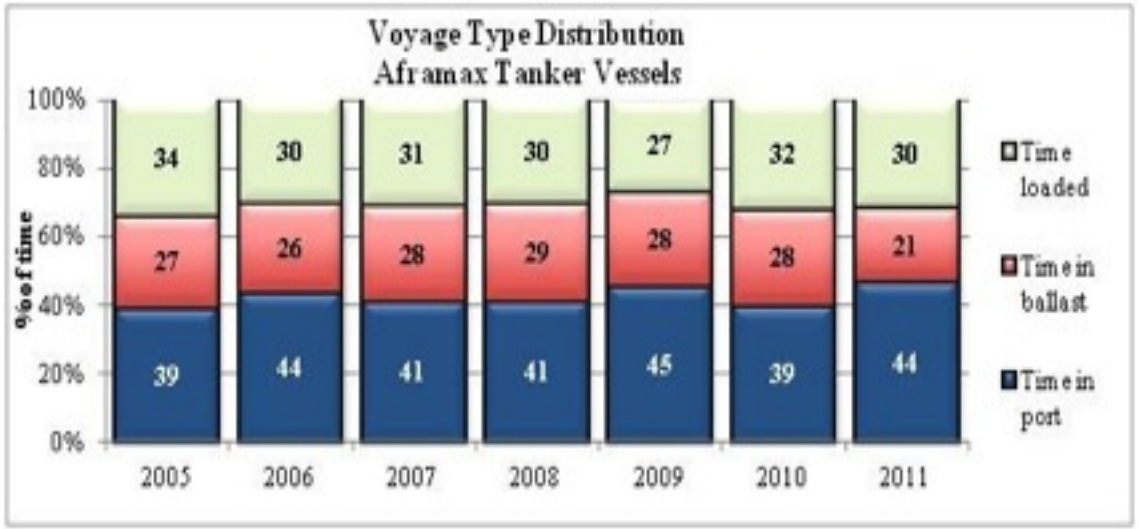
Operating Profiles
Voyage type distribution

- For all graphs there does not appear to be a strong increasing or decreasing trend over the years



Operating Profiles
Voyage type distribution

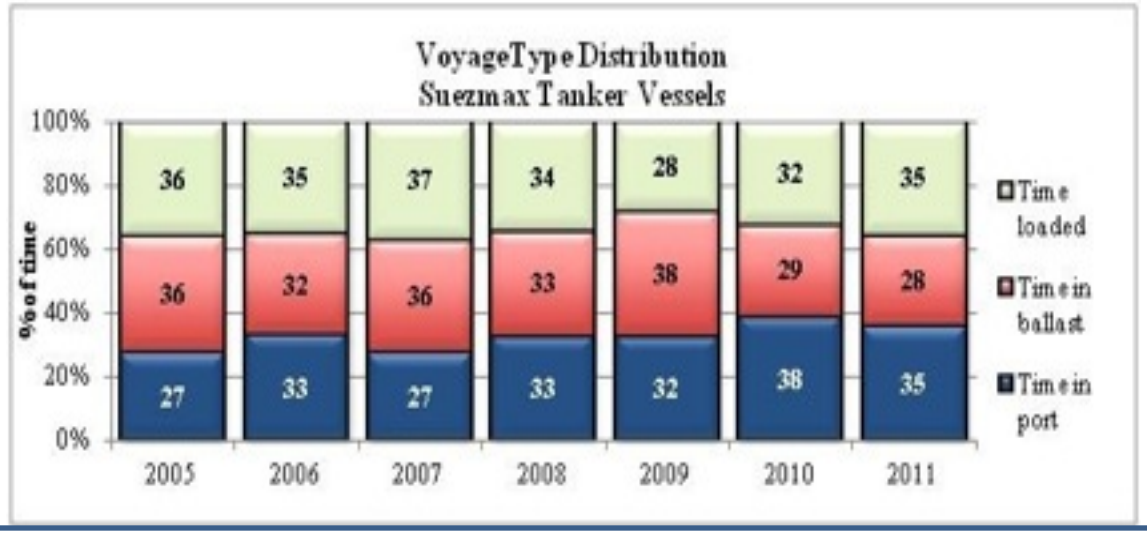




Larger tankers spend less time in port

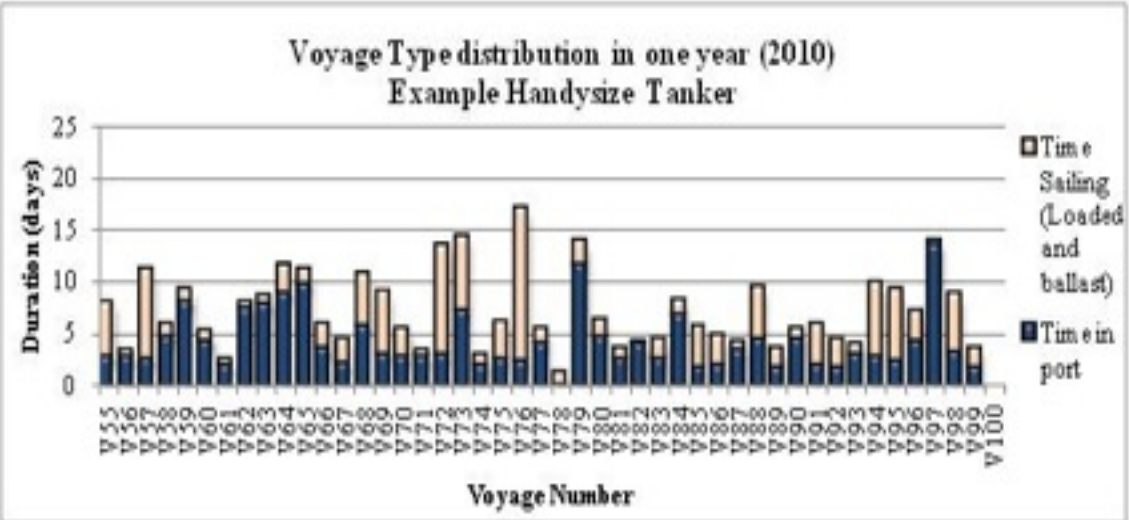
Larger tankers spend more time laden

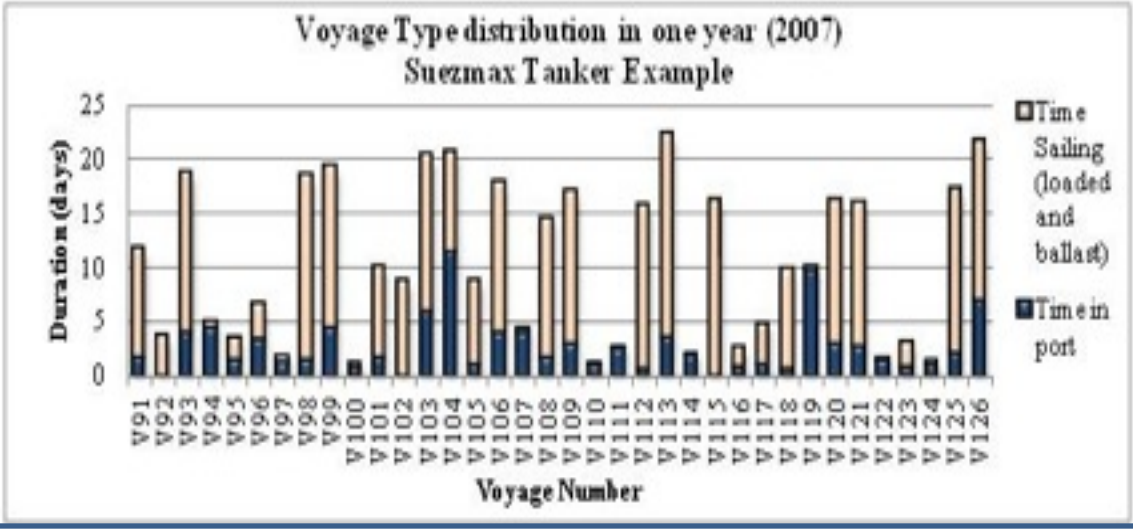
Handysize tankers spend less time in ballast



Operating Profiles
Voyage type distribution

- The handysize tanker makes more voyages in a year
- There are differences in the time spent in port

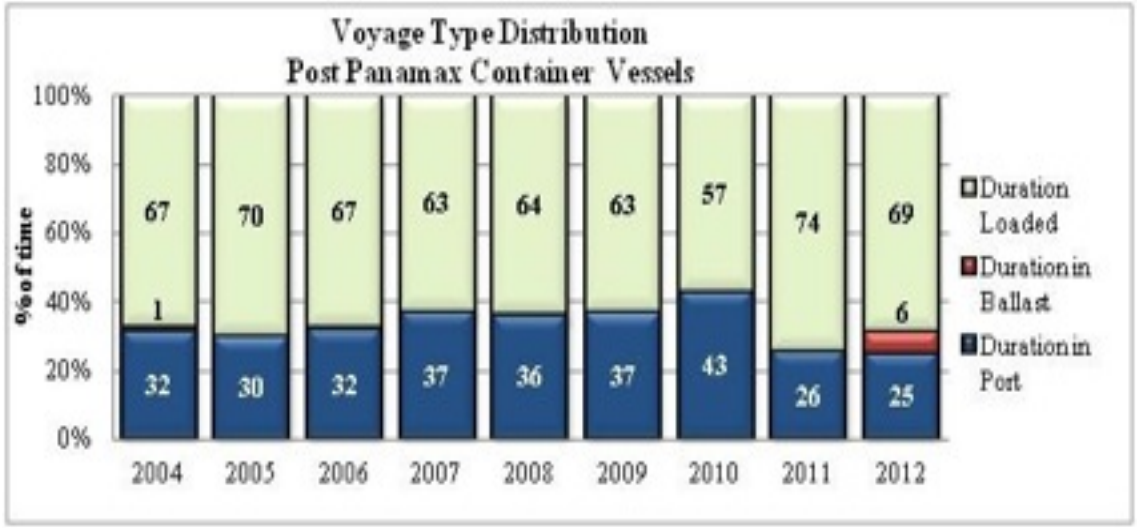


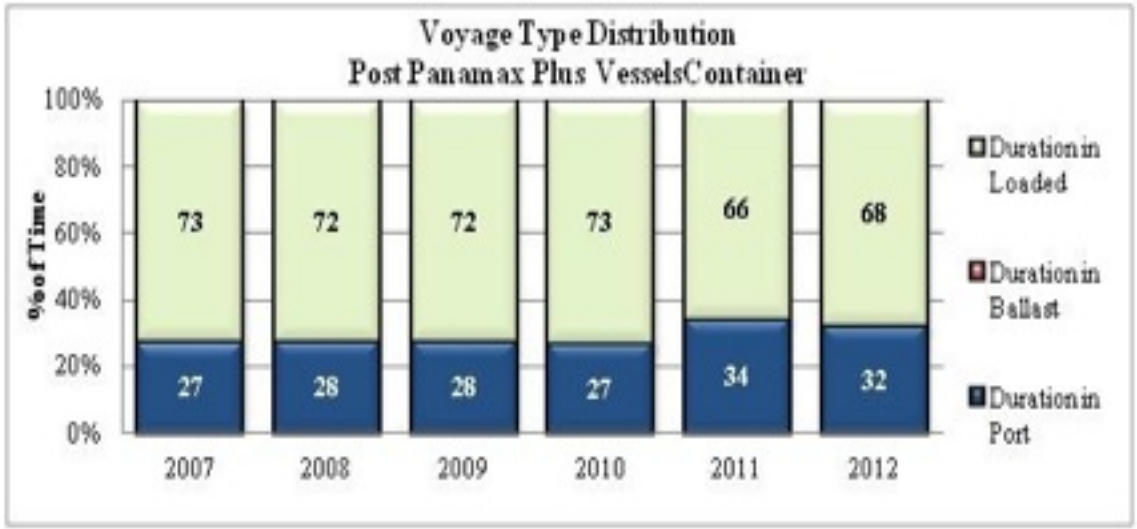


Operating Profiles
Voyage type distribution

- No ballast run
  - The % in ballast shown is not considered normal operation and can be attributed to two individual voyages

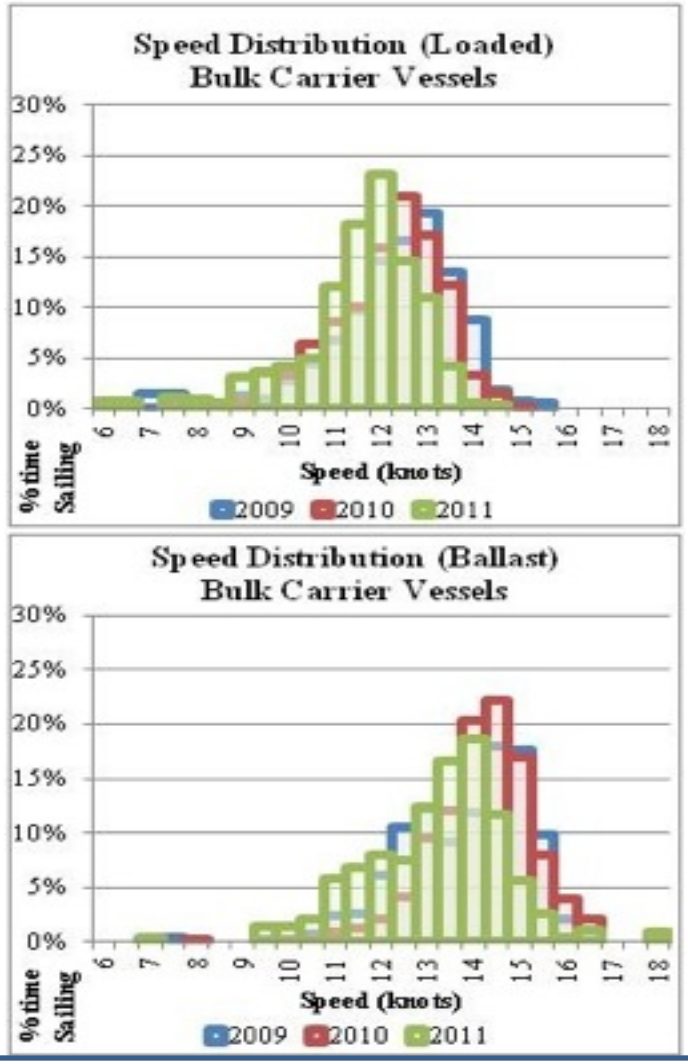
- The Post Panamax Plus container vessels spend less time in port



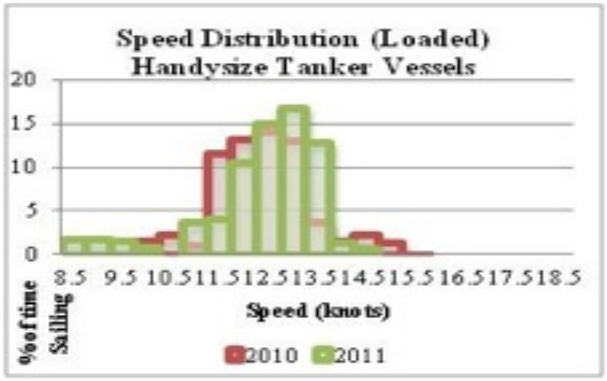


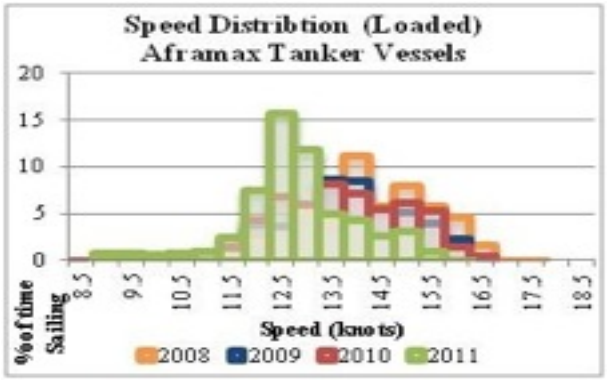
Operating Profiles
Speed distribution

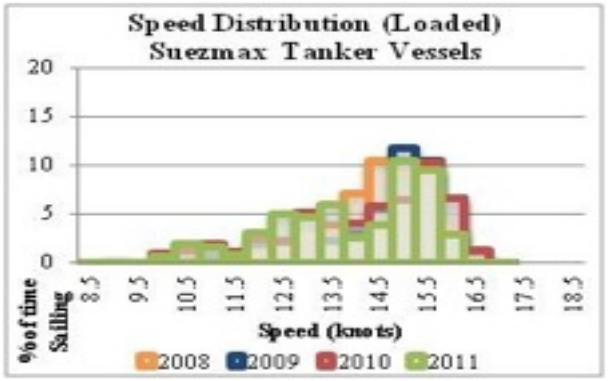
- The bulk carriers operate faster in ballast than in laden
- Over the years the most common operating speed has decreased and operational speeds have become more distributed towards lower speeds
- Loaded speeds have become more distributed than ballast speeds

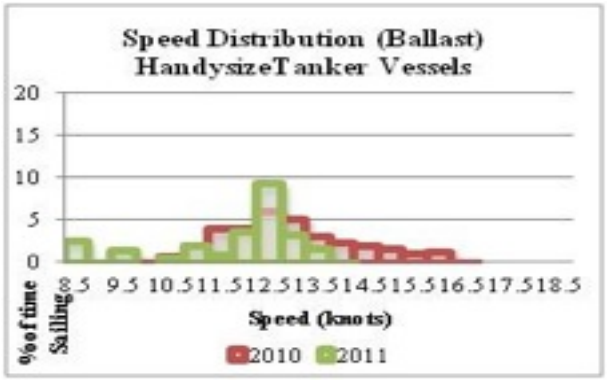


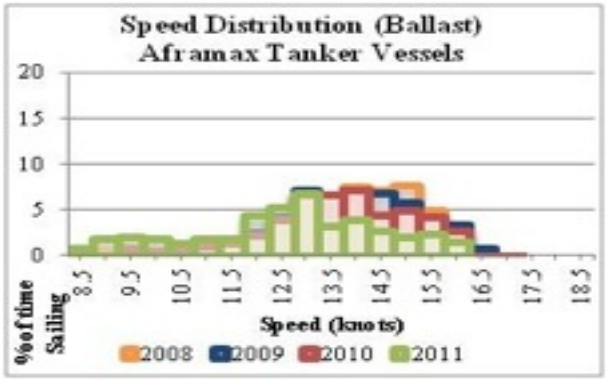
Operating Profiles
Speed distribution

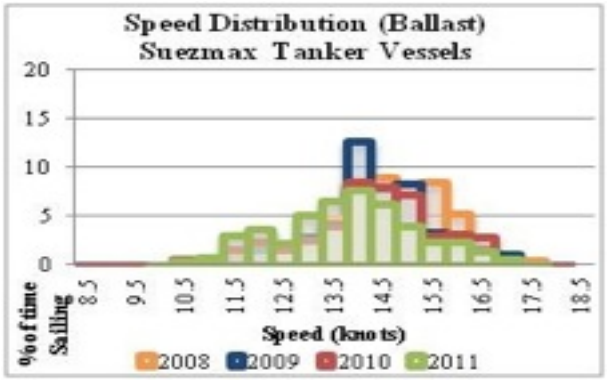








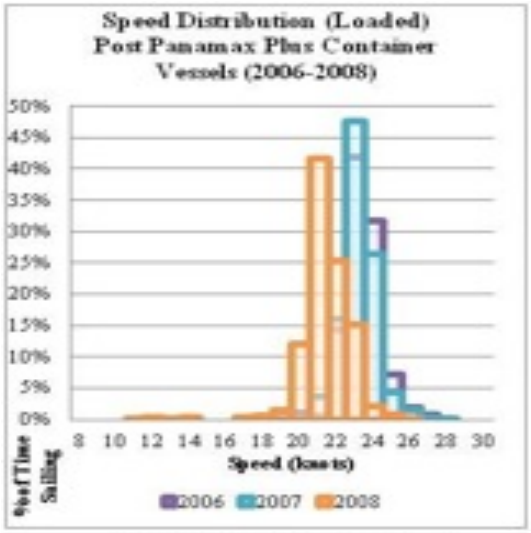


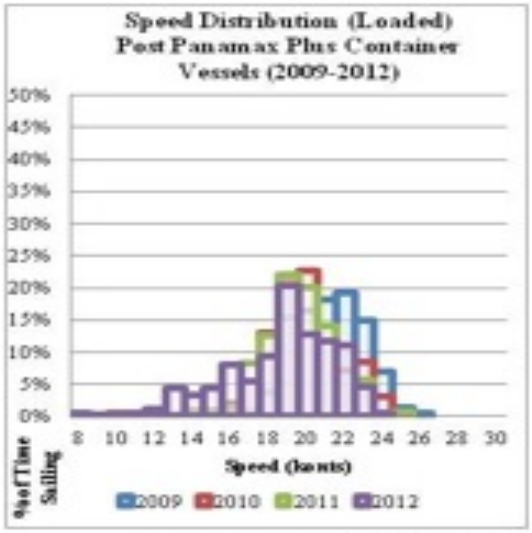


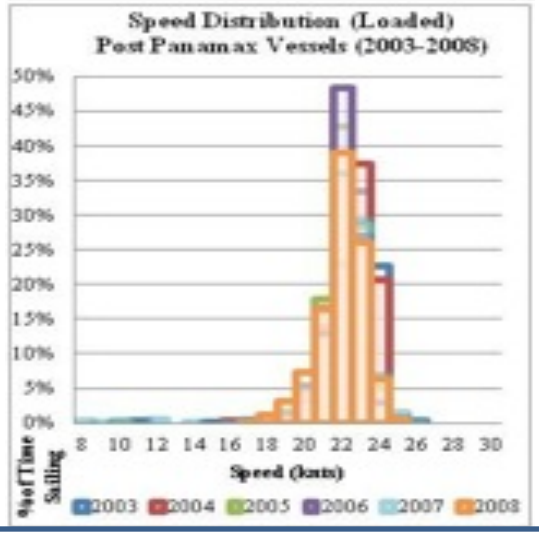
- Speeds have not changed dramatically between 2008 and 2011 but the distribution has moved towards lower speeds.
- This is most predominant for the case Aframax tankers

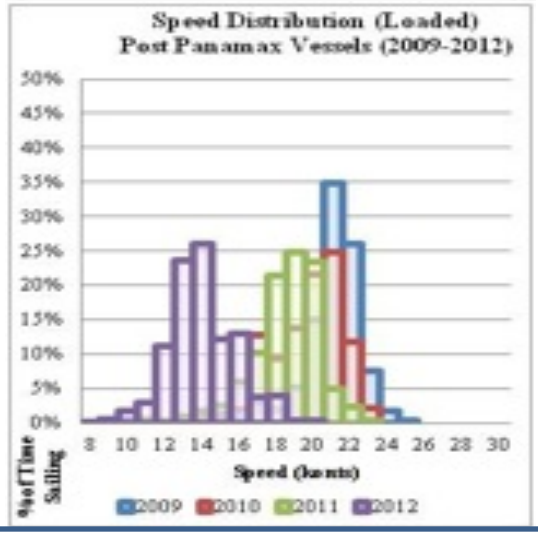
Operating Profiles
Speed distribution

- Data was available from 2006 to 2012 for the case container vessels.
- There is a very clear increase in time spent at lower operational speeds.

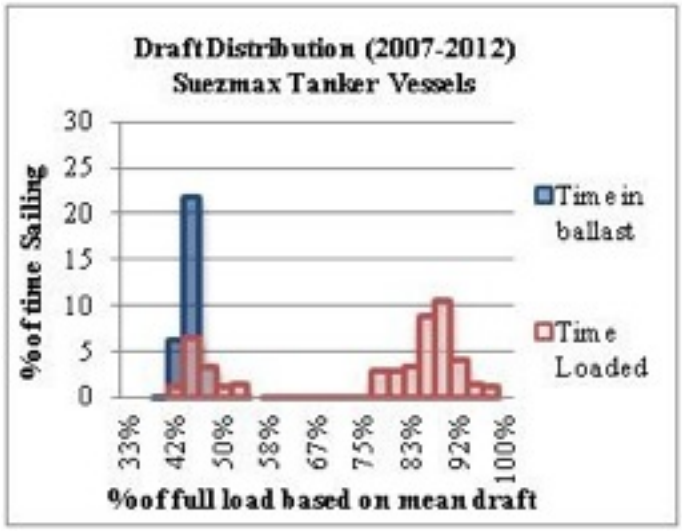


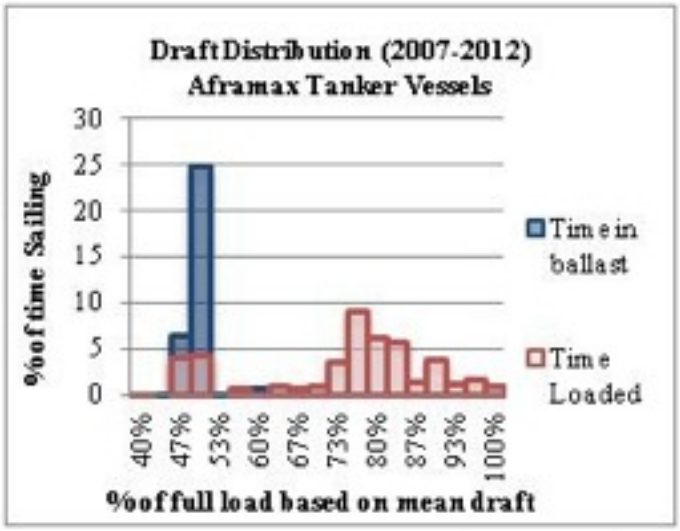




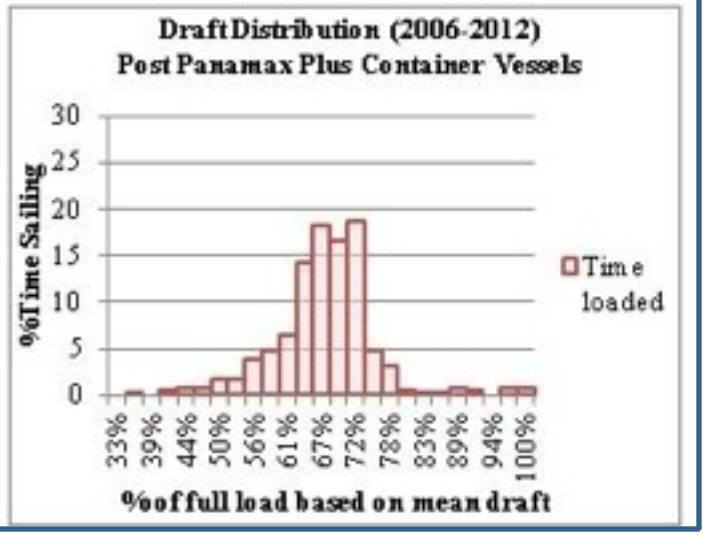


Operating Profiles
Draft distribution





- Ballast drafts are relatively constant (restricted by propeller immersion)
- Operational mean drafts (cargo loaded) range between 60%/70% and 100%



Usefulness of understanding profiles

- Operating profiles can be used for:
  - For modelling and estimating carbon emissions
  - Improving ship design by selection of the most appropriate parameters for operational profiles
  - Improving ship design by designing for a range of design points
  - Improving ship operation by considering the most appropriate cost effective energy efficient measures for the current actual operation of ships

Conclusions

- The amount of time spent in port, sailing laden and sailing in ballast varies for each ship type
- Over the past three years specifically, a wider range of operational speeds have been observed and the distribution has shifted towards lower speeds.
- There is little distribution of drafts used whilst sailing in ballast
- There is a range of operational drafts utilised when laden
  - From fully loaded to 70% for the case Aframax tankers, 77% for the case Suezmax tankers and 60%, and Post Panamax Plus container vessels

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