Eco-Ship Feasibility

Under supportive feedback from DNV • GL

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Previous Hanjin Shipping
S&P Manager and Researcher
Eco-Ship Feasibility

... Fuel efficiency of container fleet over time and vessel size
Contents

What is Eco-ship
Where We Are
Feasibility
Assumptions
Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

What is Eco-ship

Operator-Owners
- Economies of Size than Eco-ship

Conventional Owners and Financiers
- Are Charterers Willing to Fix Eco-ship

Yards
- Design Pressure versus Market Sustainability

☞ How much ‘eco’ should future eco-ships be for market feasibility?

SOURCE: ex-Hanjin, inner research
Assumptions
Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

What is Eco-ship

- MARPOL ANNEX
- IMO-SEEMP
- ECA
- Wind-resistant M&H, Bubble-coatings
- Turbo-Charger, Heat-Recovery
- Propeller(*from yard’s R&D, maker)

Bow, Solar, Wind-panels (* NYK ‘2030, carrier)
LNG-cells (*BYD Car: Lithium, part-maker)

< Volume Growth for Last Two Decades >

SOURCE: ex-Hanjin, inner research

☞ Cash-tight operators not really ready to take new technology for premium

SOURCE: Clarksons, Clarksons Research Container Department(Dr. Stopford)
### Assumptions
Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

#### What is Eco-ship

<table>
<thead>
<tr>
<th>Previous Fleet Operation</th>
<th>Future Fleet Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>▪ Operation with Second-hand Vessel                                                      ▪ Sector Shift, Supply-Demand Squeeze</td>
<td></td>
</tr>
<tr>
<td>▪ Slot-sharing between local partners                                                    ▪ Slot, Terminal-Inland Operation, EQ: Expertise and skill-sharing scheme</td>
<td></td>
</tr>
<tr>
<td>▪ Upon maturity of vessel charter-tenure, enter into new building contracts               ▪ Eco-ships, but only selected trades, more cascading(s)</td>
<td></td>
</tr>
<tr>
<td>▪ Speculative new building when vessel prices rise, more ships per loop                   ▪ Most charter-owners already possess ample eco-ships</td>
<td></td>
</tr>
<tr>
<td>▪ Slow steaming                                                                          ▪ More slow steaming (‘Extra’-slow steaming, ‘Super’-slow steaming)</td>
<td></td>
</tr>
<tr>
<td>▪ Scope-Incremental Consumption                                                           ▪ Vessel Age Incremental Consumption</td>
<td></td>
</tr>
<tr>
<td>▪ ULCS(ULCV) in Supply-Demand Squeeze (against ‘EEE’-sized scales’ cost benefits)        ▪ Yards design under pressure as room for more eco-ships are not big enough</td>
<td></td>
</tr>
<tr>
<td>▪ Operators now just too cash-stricken to swallow-in eco-ship premiums</td>
<td></td>
</tr>
</tbody>
</table>

SOURCE: ex-Hanjin, inner research
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Where We Are

Volume growth always super-ceded economic growth frictions: High or Low

Demands
- Recovery from Europe and also at US, recently

Supply
- Additional 20,000TEU under discussion with yards

Yards
- Product Portfolio Being Tested to other sectors, e.g. Power Industry, FPSO, etc.

SOURCE: HIS Global Insight(ex-DRI WEFA), Analyst & JOC Columnist
Professor Ben Hackett, CEO of Hackett Industry: http://www.thehackettgroup.com

Hae Joon RHEE, alias Rick (previous- Hanjin Shipping S&P manager and Researcher)
Assumptions
Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

Where We Are

< Not Much Scrap Candidates >

<table>
<thead>
<tr>
<th>Class</th>
<th>Average Age</th>
<th>Built</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>17.685</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>10.6355</td>
<td></td>
</tr>
<tr>
<td>3000</td>
<td>12.0304</td>
<td></td>
</tr>
<tr>
<td>4000</td>
<td>7.4796</td>
<td></td>
</tr>
<tr>
<td>5000</td>
<td>8.1585</td>
<td></td>
</tr>
<tr>
<td>6000</td>
<td>5.6453</td>
<td></td>
</tr>
<tr>
<td>7000</td>
<td>5.8888</td>
<td></td>
</tr>
<tr>
<td>8000</td>
<td>4.1812</td>
<td></td>
</tr>
<tr>
<td>9000</td>
<td>4.0441</td>
<td></td>
</tr>
<tr>
<td>10000</td>
<td>2.4285</td>
<td></td>
</tr>
<tr>
<td>11000</td>
<td>1.1875</td>
<td></td>
</tr>
<tr>
<td>12000</td>
<td>0.3333</td>
<td></td>
</tr>
</tbody>
</table>

< Consumption Dynamics >

Vessel Age (NM Efficiency)

Source: Global Insight Global Macro and World Trade Services

Fleet Optimization, Economies of Size

(New-Building Needs)

Source: HIS Global Insight(ex-DRI WEFA), Analyst & JOC Columnist
Professor Ben Hackett, CEO of Hackett Industry: http://www.thehackettgroup.com, with private source and experience
Assumptions
Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

Where We Are

- Super-Cycle was Triggered by China WTO, aftermaths of New Building Surge
- For Eco-Ship Boom, May Need Another China
- Current Premium of Eco-Ship are Not Reflecting Future Risks

< Tanker Market – World Scale >

Source: SSE China, UNCTAD

< Container Market – Shanghai Container Freight Index >

Source: SSE China, UNCTAD

BDI

2008 Super-Cycle: BDI was at 11,793 ~!!!

"14 Feb 1,140  "14 Mar 1,484

"14 Feb 1,674  "14 Mar 2,766

Source: Clarksons

SOURCE: HIS Global Insight(ex-DRI WEFA), Analyst & JOC Columnist
Professor Ben Hackett, CEO of Hackett Industry:
http://www.thehackettgroup.com, methodology with private experience
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Feasibility

<Alphaliner 2009 Loop-Cost Study on HAM-SHA>

Source: Alphaliner, Singapore

<Alphaliner 2009 Speed-Consumption Study>

Source: Alphaliner, Singapore
**Assumptions**

Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

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**Most Recent PEF investment into Shipping Sector**

- Value ($mil)

Source: Private, ex-Hanjin inner research

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**Baltic Exchange Index**

- Dirty Tanker Index
- Clean Tanker Index

Source: Baltic Exchange, UNCTAD

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- Post sub-Prime PEF Investment into Shipping Sector

| Leasing company formed by Regions Bank and the Royal Bank of Scotland |
| Global Hunter Securities Trailer Bridge |
| JP Morgan Consortium led by WL Ross & Co. (First Reserve Corporation, China Investment Corporation) |
| Alterna Capital Partners |
| Apollo Management |
| Kelso & Company |
| Littlejohn/Northern |
| Kelso & Company |
| Carlyle |
| Eton Park/Rhone Capital |
| Greenbriar Equity Group |
| Sterling Partners |
| Fortress Investments |
| Blackstone/Cerberus |
| New Mountain Capital |

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**Source:** Marine Money, Ship Finance Forum (Singapore), Baltic Exchange
Assumptions
Technology Development Out-Pacing Vessel Operators’ Fleet Management Skills

Feasibility

Handymax and Below(*)
- Annual $600,000~$700,000 Cost Favor in Addition to Minor Frictions to Supply-Demand

Post-Panamax and Above Handymax
- Annual $250,000~$300,000 Cost Favor in Addition to Less Supply-Demand Frictions

New Post-Panamax to ULCS, ULCV (and above) (*)
- Annual $550,000~$700,000 Cost Favor in Addition, Creation of Additional Volume to Load Full till BEP Level(s)

* Handymax and below class container ships are relatively old, but operating at slower speed than main East-West, thus eco-friendly must have additional merits than just fuel-savings

** New Post-Panamax to ULCS, ULCV class are pretty eco-type, and newly designed vessels must be far more competitive than their latest design. (i-phone’s ‘Cannivalization’ in Shipping)

SOURCE: Private, ex-Hanjin inner research
Contents

Q&A
Contact: rick@heung-a.co.kr
ECO Ships – Chances and Challenges

Discussion with Rick RHEE, former Hanjin Researcher

Shipping Advisory

Hamburg – May 21st, 2014
Today’s vessels will have to compete against vessels that are 30% more fuel efficient in the future.

Transport costs, USD/TEU/1000 NM

1. IMO with respect to required EEDI improvement (MEPC 60/4/14)

ECO Ships - Chances and Challenges

02.06.2014

SOURCE: DNV · GL inhouse research
The favourability of new optimized vessels vs. average existing vessels is significant at today’s operating conditions.

**SPEED: 19 KNOTS**

**Reasons for better cost position of new optimized vessels**

- Improved *propulsion* efficiency due to lower rpm
- Higher efficiency of *engines*
- Reduced *hull* resistance due to optimization for lower target speeds
- Better specific costs due to higher *TEU intake* (at 14t) due to less ballast

- **Less steel** work due to shorter vessels at same capacity
- Better specific costs due to higher *TEU intake* (at 14t) due to less ballast
- Stronger *competition* of yards for newbuilding contracts

- Less *lubrication oil* consumption of smaller engines
- Better *supporting systems* of modern engines
- Less *maintenance* effort of shorter vessels
- Better specific costs due to higher *TEU intake* (at 14t) due to less ballast

---

**ECO Ships - Chances and Challenges**

02.06.2014

**SOURCE:** DNV • GL inhouse research
Panamax vessels show the most significant difference between average existing vessels and new optimized vessels.

<table>
<thead>
<tr>
<th>Ship Size</th>
<th>Average Existing Vessel</th>
<th>Optimized New Vessel</th>
<th>CAPEX</th>
<th>OPEX</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,500 TEU</td>
<td>77</td>
<td>56</td>
<td>13</td>
<td>14</td>
</tr>
<tr>
<td>4,500 TEU</td>
<td>75</td>
<td>40</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
<td>9,500 TEU</td>
<td>55</td>
<td>36</td>
<td>23</td>
<td>13</td>
</tr>
</tbody>
</table>

**SPEED: 19 KNOTS**

1. 750 USD/t HFO, operating speed 19 knots, excl. port and canal costs

**ECO Ships - Chances and Challenges**
02.06.2014

**SOURCE:** DNV • GL inhouse research
Case study Panamax container vessel (1/3) – with slow steaming the operating pattern changed strongly compared to initial design

Initial vessel design

Main dimensions
- LPP
- B
- D
- Speed
- Container (nominal)
- Container (@14t)
- Power
- Fuel oil consumption

Optimization
- Meet design speed at design draft at sea trial (full load, one point)
- Minimize newbuild costs (engineering, building equipment installed)

Current operations

Actual operations
- 24.5 kn
- 22.0 kn
- 20.0 kn
- 17.0 kn
- 14.0 kn
- Port

Speed/draught matrix

Saving from slow steaming

-49%

EXAMPLE

SOURCE: DNV・GL inhouse research

ECO Ships - Chances and Challenges

02.06.2014
Case study Panamax container vessel (2/3) – various measures help optimizing the vessel for today’s operating pattern

<table>
<thead>
<tr>
<th>Item</th>
<th>Saving</th>
<th>Invest.</th>
<th>Payback¹</th>
<th>Saving from retrofitting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bow</td>
<td>~ 6%</td>
<td>~ 600 k USD</td>
<td>~ 9 months</td>
<td></td>
</tr>
<tr>
<td>Propeller</td>
<td>~ 3%</td>
<td>~ 250 k USD</td>
<td>~ 6 months</td>
<td>~75</td>
</tr>
<tr>
<td>Turbo-charger</td>
<td>~ 3%</td>
<td>~ 250 k USD</td>
<td>~ 6 months</td>
<td>~37</td>
</tr>
<tr>
<td>Systems</td>
<td>~ 1%</td>
<td>~ 80 k USD</td>
<td>~ 8 months</td>
<td>~-49%</td>
</tr>
</tbody>
</table>

1. 750 USD/t HFO, if measures are implemented during dry docking planned anyway

ECO Ships - Chances and Challenges

02.06.2014

SOURCE: DNV · GL inhouse research
Case study Panamax container vessel (3/3) – retrofitting provides advantage vs. market average, but new vessels are out of reach

Whom do you need to beat?
The few optimized new vessels currently entering the market?
The majority of the 600+ Panamax vessels sailing today?

SOURCE: DNV · GL inhouse research
A market average of bunker cost in USD per 1,000 TEU nautical miles is calculated based on the operating profiles.

- Each square represent a ship in the current world container fleet (except vessels with missing data).
- Economies of scale for larger vessels are clearly shown by sinking trend of the USD per 1,000 TEU NM cost curve.
- A large spread in bunker cost per 1,000 TEU nautical miles can be seen for all vessel size groups.

Source: IHS Fairplay, DNV GL

ECO Ships - Chances and Challenges
02.06.2014

SOURCE: DNV · GL inhouse research
ECO Ships – Chances and Challenges

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ECO Ships - Chances and Challenges

SAFE, SMARTER, GREENER

ECO Ships - Chances and Challenges

02.06.2014

SOURCE: DNV • GL inhouse research
Q & A

Contact: rick@heung-a.co.kr

Hae Joon RHEE
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