A Basic Study on Marine Traffic Assessment in Mombasa Approach Channel-I

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Abstract: Mombasa is the principle port of Kenya, serving hinter countries in Eastern and central Africa. Mombasa port has undergone a massive infrastructure upgrade and dredging works with an expectation that more vessels and large post Panamax ships will be able to call at Mombasa port. Therefore, it is vital to carry out a marine traffic risk assessment so as to quantify the degree of navigation safety on Mombasa approach channel and also to evaluate navigation risk imposed on transit traffic by local ferry traffic. In this paper marine traffic risk assessment is carried out using IWRAP mk2, Environmental Stress model, and PARK model. Risk assessment results show that Likoni area has unacceptable stress/ risk ranking at 20.7% on ES model and 38.89% by PARK model. IWRAP mk2 model shows that crossing area has the highest risk of crossing collision and the area at the entrance to inner channel has a high risk of grounding. The conclusions derived from this study will provide the basis for proposing the most effective countermeasure so as to improve navigation safety in Mombasa approach channel.

Key Words: Risk Assessment, navigation safety, IWRAP mk2, Environment Stress, PARK model

1. Introduction

What’s the need for Marine Traffic Assessment?
> To quantify degree of navigation safety
> To evaluate navigation risk imposed on transit traffic by local ferry traffic

Introduction

Method of Assessment

Five day AIS data collected in 10TH to 14TH August 2015 at Mombasa Port.

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2. Research Target Area

- 7 nm long
- Inner Channel: Depth = 15m, Outer Channel: Depth = 17.5m
- Marked by 10 buoys (IALA region A)
- Width is 300m
- Old port depth is 11.2m

3. Description of Marine Traffic

- Five day AIS data observation
- GATE A

4. Environmental Stress (ES) Model

The ES model (Environment Stress model) assesses the degree of stress imposed by topographical AND/OR traffic environments on a mariner, in quantitative terms.

Theoretical basis of ES Model

- ESS (ES Ship): evaluation of ship handling difficulty arising from restrictions on the freedom to make collision-avoidance maneuvers
  
  \[ ES_X = \sum (S_{ij}) \]

  \[ S_{ij} = \alpha \times (TTC \times V / Lm) + \beta \]

  \[ \alpha = \begin{cases} 0.0 & : Crossing free STER \[ \beta = \begin{cases} 0.0 & : Crossing from Port \[ \beta = 0.0 & : \text{Outboard situation} \end{cases} \end{cases} \]

  \[ \text{TTC} \times V / Lm \]

  \[ \text{SIS} : \text{Subjective Judgment for Ship} \]

  \[ \text{TTC} : \text{Time to Collision to ship} \]

  \[ V : \text{Relative speed} \]

  \[ Lm : \text{Mean of two ship's length} \]
ES Model plot from real time survey

<table>
<thead>
<tr>
<th>Stress Value</th>
<th>Transit Traffic</th>
<th>Ferry Traffic</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-150 - ETL 3.5&lt;900</td>
<td>238</td>
<td>25.2</td>
<td>374</td>
</tr>
<tr>
<td>750&lt;ETL&lt;3.5&lt;900</td>
<td>37</td>
<td>2.9</td>
<td>91</td>
</tr>
<tr>
<td>ETL&gt;3.5</td>
<td>296</td>
<td>22.1</td>
<td>108</td>
</tr>
</tbody>
</table>

Potential Assessment of Risk (PARK) Model

1. Type of ship
2. Tonnage
3. Length
4. Width
5. Career
6. License
7. Position

PARK model (Potential Assessment of Risk model)

1. Crossing situation
2. Approaching side
3. In/out of harbor
4. Speed correlation
5. Speed difference
6. Distance

Risk value of own ship in relation to target ship in surrounding

Summary:
- PARK model confirms that Likoni channel is a potential high collision risk area for transit traffic

Comparison with Istanbul Strait

Sector A2 of Istanbul strait (Aydogdu, 2012)

PARK Model Risk Plot

IWRAP Mk2 Program

Assessing collision and grounding probabilities. Recommended by IALA
Traffic Distribution from TOAIS

<table>
<thead>
<tr>
<th>Lane</th>
<th>Mean (m)</th>
<th>Standard Deviation (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lane 1</td>
<td>26.5</td>
<td>7.4</td>
</tr>
<tr>
<td>Lane 2</td>
<td>22.5</td>
<td>8.9</td>
</tr>
<tr>
<td>Lane 3</td>
<td>18.5</td>
<td>10.1</td>
</tr>
<tr>
<td>Lane 4</td>
<td>14.5</td>
<td>12.1</td>
</tr>
<tr>
<td>Lane 5</td>
<td>10.5</td>
<td>14.1</td>
</tr>
<tr>
<td>Lane 6</td>
<td>6.5</td>
<td>16.1</td>
</tr>
<tr>
<td>Lane 7</td>
<td>2.5</td>
<td>18.1</td>
</tr>
</tbody>
</table>

IWRAP Mk2 Result

<table>
<thead>
<tr>
<th>Incident</th>
<th>Frequency/grounding/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collision</td>
<td>0.25</td>
</tr>
<tr>
<td>Grounding</td>
<td>0.10</td>
</tr>
<tr>
<td>Vessel grounding</td>
<td>0.05</td>
</tr>
<tr>
<td>Total grounding</td>
<td>0.40</td>
</tr>
<tr>
<td>Total occurrence</td>
<td>2.00</td>
</tr>
</tbody>
</table>

5. Conclusion

1. Likoni channel, where ferry crosses, has unacceptable total stress level of 20.7% from ES model and 36.98% from PARK model. Therefore it is considered a high potential collision risk zone for transit traffic.

2. Powered grounding frequency in Mombasa is approximately twice that of Ulsan waterway.

3. Crossing region, where local ferry operate, has the highest risk of crossing collision.

Recommendation

- Enforcement of Speed limits
- Traffic Control at Likoni area
- Route change/ separation line
- Buoy establishment/change

THANK YOU