Paper for Consideration by MACHC

Risk Assessment in Maritime Navigation for the Greater Caribbean Region (GCR)

Submitted by:	University of West Indies
Executive Summary:	This study gives an assessment of the work that has been undertaken by LINZ with a view to reviewing the applicability and modifications necessary for risk assessment in the GCR
Related Documents:	See list of references
Related Projects:	N/A

Introduction/background

This study gives an assessment of the work that has been undertaken by Land Information New Zealand (LINZ) across the islands of the South West Pacific Ocean with a view to reviewing the applicability and modifications necessary for risk assessment in the GCR.

Analysis/discussion

In recent years there has been a significant growth in large cruise-vessel visits to the South West Pacific (SWP); navigating in poorly charted areas. In anticipation of the riskiness involved, LINZ developed a hydrographic risk assessment methodology to assist decision makers in prioritising areas for hydrographic surveys. The methodology was used in the Vanuatu proof of concept pilot study in 2013 and the results have since been published. The methodology was also applied to The Kingdom of Tonga (2014), the Cook Islands (2015), and Niue (2016) (Greenland 2013).

The LINZ hydrographic risk assessment methodology applies risk terrain modelling within a Geographic Information System to perform a weighted overlay on shipping routes for both SOLAS and domestic traffic in relation to traffic type, size and volume which are weighted against 14 consequence criteria and 15 likelihood criteria (Marico Marine 2013). In order to effectively compare the levels of risk, the EEZ is covered by a grid and divided into cells of 2.5 km by 2.5 km. This grid is the common framework that combines all the inputs and is used to map the computed risk scores. The levels of risk range from 1 – 5 with 1 being an area of insignificant risk and 5 being an area of significant risk. The resulting risk levels are comparative in nature and are displayed in the GIS as a coloured heatmap, making it easier to visualise and interpret (Land Information New Zealand ; Rod Nairn and Associates Pty Ltd 2016).

The methodology then uses the weighted overlay to calculate the benefit/cost of carrying out hydrographic surveys in areas found to be at risk. For the benefit/cost analysis, each grid cell includes the cost of surveying, the loss-of-life reduction benefit per annum, the pollution reduction benefit per annum and the economic development benefit per annum. The methodology calculates the loss-of-life costs as well as the pollution costs on a per annum basis, first without hydrographic surveying and secondly with hydrographic surveying, using potential economic development parameters per grid cell. The difference between these two values gives the benefit per annum. The net present value is then conducted using the survey cost, a 2% interest rate and a sum of the benefits. The assessment is made for a ten year projection where the benefits are recognised once the surveying has been completed (in year two) (Marico Marine 2015).

Later in 2016, the methodology was modified to identify areas at risk of a maritime incident in the waters of New Zealand. For this study, the methodology used a GIS based risk model of shipping routes, 17 consequence criteria and 18 likelihood criteria with a level of risk from 1 - 5 assigned to each cell within the layer. Using this modified methodology, the cell resolution varied from ports and harbours, to the territorial sea limit, to the EEZ, with greater

granularity in the ports & harbours where vessel movement becomes more dangerous (See Figure 1) (Caie, LINZ Hydrography Risk Assessment 2016).

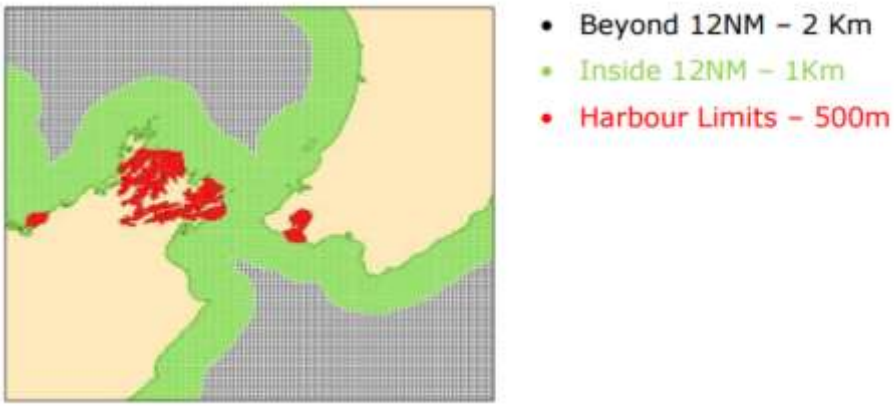

Figure 1: Cell Resolution used in the Risk Model for the New Zealand Hydrographic Risk Assessment

Source: Caie, New Zealand Hydrography Risk Assessment 2016

As opposed to the benefit/cost analysis, the New Zealand hydrographic risk assessment applied a charting benefit methodology to determine whether improving the zone of confidence rating on the nautical chart at a location found to be at risk would lower the risk. To do this, a weighted overlay was used to model the characteristics of chart adequacy which were chart scale and extents, chart quality (zone of confidence) and survey age (Caie, New Zealand Hydrography Risk Assessment 2016).

In the case of the Caribbean Sea, the International Hydrographic Organization (IHO) (2014) found that more than eighty percent of Caribbean waters between 0 – 200 meters deep were either un-surveyed or requires better data. Further, the database of the International Maritime Organization (IMO) shows that over the past 15 years, there were 20 groundings, 8 vessel-to-vessel collisions and three contacts with fixed objects. Most of these incidents have been due to human error, often associated with severe weather conditions and 2 have been documented to be due to hydrography. It must be noted however that not all maritime incidents are reported (Miller 2015). Hydrographic surveys and nautical charting services are therefore important for the safe and efficient navigation of vessels, but these services are expensive.

This paper suggests that the methodology developed by LINZ can be applied to the GCR to identify areas at risk using inexpensive data which are available in the public domain as well as governments' data repositories. Expert judgment to identify hazards and estimate their risks to people, property, environment and stakeholders as well as the benefit of improving the confidence of nautical charts in these areas can also be incorporated. This paper also suggests a modification of the methodology developed by LINZ and well as that used in NZ in anticipation that it will give a better fit to the GCR maritime area. The following are therefore suggested:

1. The type, size and frequency of vessels transiting the waters of New Zealand are more similar to those in the GCR than the smaller islands of the SWP. The methodology applied to New Zealand would therefore be more applicable to the GCR.
2. The traffic density across the smaller islands of the SWP was relatively low and there was a lot of through traffic in the territorial waters. It was therefore feasible to employ the risk assessment on an island by island basis. In contrast, there is a relatively high traffic density across the GCR with many vessels visiting the islands. With this being the case, it would be useful to employ the methodology across the GCR as a whole.

Alternatively, the GCR would be broken into four blocks where the northern, eastern, southern and western islands would each be analysed as an entity.

3. The marine resources, economy and stakeholders across the GCR differ from those across the islands of the SWP and New Zealand; therefore the risk criteria weighted for that region should not be used as exist but rather re-weighted – taking into consideration the characteristics of the GCR.
4. Port of call logs were used to ground truth the S-AIS data for the studies done in the SWP. Additionally, the shipping routes of domestic vessels were included in the risk assessment. This process would only be possible for the studies across the GCR if data is made available by local port authorities.
5. For the studies being done in the GCR, a model would be created to assess the benefit/cost or the charting benefit of improving the confidence of nautical charts. This would be done because the benefit/cost and chart benefit models were not made available and cannot be replicated based on the published information.
6. An 'in country' risk matrix was used for each island of the SWP. The 'in country' risk matrix was created by setting unrelated categories within the consequence and likelihood criteria to zero so that the remaining categories within each criteria would receive a higher weighting and the overall category would retain its relative importance (Land Information New Zealand ; Rod Nairn and Associates Pty Ltd 2016). Conversely, a 'regional' risk matrix would be used for the GCR where the risk weightings of unrelated categories within the EEZ of each island would not be set to zero. The regional assessment ensures that all assessments are comparable to each other.

In conclusion, the hydrographic risk assessment developed at LINZ is a robust, evidence based and low-cost methodology which should be modified and applied to the GCR to ensure the safe and efficient navigation of vessels.

Conclusions

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Recommendations

None.

Action Required of MACHC

The MACHC is invited to:

a. note this report
b. take any action as appropriate

References:

A list of references is provided in the next page.

References

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