

ASSESSING THE INCREASING RISK OF MARINE OIL POLLUTION SPILLS IN CHINA

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ABSTRACT

As the Chinese economy continues to develop at a rapid pace, shipping has also increased significantly over recent years. This rise in traffic brings a greater threat of oil pollution from vessels. Assessing the risk of oil spills can be a complex process, yet by modelling and analysing the amount of oil transported around coastal areas during 2001 and 2005, using data obtained from Lloyds' Marine Intelligence Unit (LMIU) and comparing it with the historical data from ITOPF's tanker spills database, an improved representation of risk can be made. Using a GIS platform to graphically visualise this information and integrate further datasets regarding local sensitivities we can understand the risk more thoroughly and present the aggregated information more effectively.

In response to the increased risk experienced in and around Chinese waters, ITOPF and other international organisations are working to build awareness of the risks and develop links with key parties through training courses and seminars. By working closely with the Chinese Maritime Safety Administration (MSA) and with the Northwest Pacific Action Plan (NOWPAP), a regional UNEP initiative, the threat of future incidents can be minimised and handled in a rational manner.

This paper looks at the risks associated with increased traffic and developments taking place to meet the threat of marine oil spills in Chinese waters.

All international industries are affected by the cycles in the global economy and the shipping industry is no different. The global economy has seen a broad-based growth in the gross domestic product (GDP) especially in developing countries and emerging market countries such as the Peoples Republic of China, India and Russia(1). Growth in East Asia accelerated to above 8% in 2006 with China reporting a GDP growth of 10.7%(2). Exports are the main driver of regional growth with the buoyant Chinese economy gaining in importance as an export destination for other East Asian economies (3).

Thanks to the economic increase there has been an increase in exports requiring shipment by sea. The world's total merchant fleet at the beginning of 2006, comprising of ships over 300gt, stands at 41,110 vessels with a tonnage of 944.5 million dwt and 10.4 million TEU (Container capacity as measured in twenty-foot equivalent units). This is a 6.4% increase in tonnage and 10.7% increase in the TEU capacity from the previous year. Worldwide 3.9 billion tonnes of fuel oil was consumed in 2006 with around a third being used by Asian countries (4). Another indicator for

shipping capacity is aggregated fuel oil consumption by region as can be seen in figure 1.

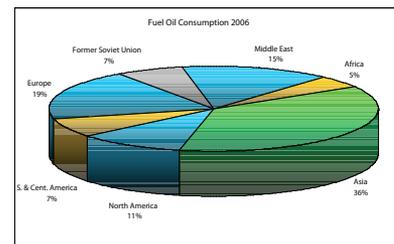


FIGURE 1: GLOBAL FUEL OIL CONSUMPTION

ASIAN SHIPPING INDUSTRY

The interest in China's economic growth has slightly masked the fact that the whole of Asia, including India has benefited in recent years from the current economic boom. Asia has the 3rd largest nominal GDP of all continents with China, Japan, South Korea and India all in the top 15 of the International Monetary Fund Gross world product list. Both China and India have been growing rapidly with a greater annual growth rate than the already substantial average Asian growth. Figure 2 demonstrates the trend in oil consumption growth since 1990 and shows that although both China and India's oil consumption growth has increased substantially over the global growth; the increase in Asia has also increased at a faster rate than the rest of the world.

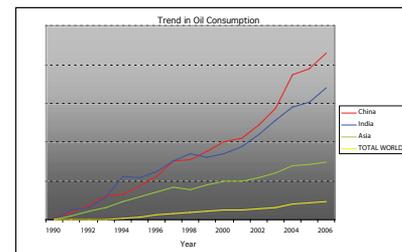


FIGURE 2: OIL CONSUMPTION TREND (BP STATISTICS)

Due to investment in new refinery capacity of several Asian countries, the need for increased marine transport for both import and export of liquid cargo will continue.

CHINESE SHIPPING INDUSTRY

Following rapid expansion in the 1990s the economy of China is presently the third largest in the world. China's domestic oil production has increased over the years to 3.1 million bbl/day but as can be seen in figure 4 this only satisfies about half of the ever-increasing national demand. The demand in oil has increased by an average of 7.9% a year from 2000-2006, whereas the world increase has been a fraction of this value at 1.5%. Oil and other commodities are imported by sea in increasing quantities making the three largest Chinese ports (Shanghai, Ningbo and Tianjin) amongst the 10 busiest in the world(5). Most of the oil imported to China is supplied from Saudi Arabia, Angola, Russia and Iran although a lot of trade is pan-Asian.

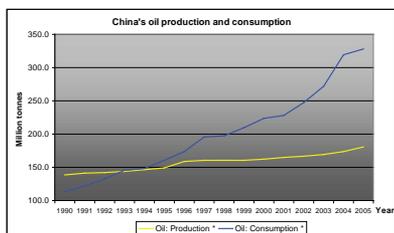


FIGURE 3: CHINA'S OIL PRODUCTION AND CONSUMPTION

* Includes crude oil, shale oil, oil sands and NGLs (the liquid content of natural gas where this is recovered separately).

The CEPT (Common Effective Preferential Tariff) scheme covers both manufactured and agricultural products and will allow greater ease in movement of goods via container. It is thought that this agreement will be fully in place by 2010 allowing the free trade of goods across ASEAN (Association of South East Asian Nations) countries signed up to the scheme. China is also a key player in shipbuilding with the two largest shipyard groups planning to double capacity by 2010. In 2006, China's shipbuilding output reached 14.52 million deadweight tons, which accounted for 19% of the global shipbuilding market and ranked third in the world.

China has over 6000 shipping companies trading in inland waters and internationally. Of all imports and export trades, 85% are closely linked to the shipping trade making the shipping industry a highly valuable asset in China's growth.

Container Vessels

2006 saw the 50th anniversary of container vessel trade. As of January 1st 2006 the container fleet stood at 3,514 ships of 111.6 Million dwt equal to 8.1 Million TEU total. This capacity grew by 13.5% during 2005. Container shipping was and is the fastest growing shipping sector. In China the container shipping market increased dramatically after China joined the WTO (World Trade Organisation) in 2001.

Out of the world's 20 leading container ports, 14 are in Asia. The port of Shanghai with ~22 million TEU (imports plus exports) is the third largest in the world. Together, Chinese ports accounted for 47% of the world's throughput in 2006-2007(6).

An incident involving a container vessel could cause a significant environmental impact due to the amount of bunker fuel the larger vessels can carry. The 'EMMA MAERSK' the largest container vessel 'EMMA MAERSK' is ~14,000 TEU and 398 metres in length carries 17,000 tonnes of high viscosity fuel oil bunkers when fully laden and with larger vessels being built, an incident could compare with that of a small tanker.

Oil Tankers

The total tanker fleet for ships over 300gt in 2006 comprised 10,401 vessels totalling 387.7 million dwt, a 5.2% increase from 2005(7). In 2006, 52,561,000 barrels of oil (crude oil and products) were transported daily, up 2.5% from the previous year, 747 million tonnes of which was imported into Asia(8).

Over the past 40 years the International Tanker Owners Pollution Federation (ITOPF) has developed and maintained a database of all marine spill incidents involving tank vessels, which covers crude oil and products including fuel oils. In addition to the maintenance of this database, ITOPF has also carried out analysis of Lloyds' Maritime Intelligence Unit (LMIU) APEX database. Our analysis looked at information on laden oil tanker shipments by 'Panamax' vessels and above ($\geq 60,000$ DWT) carrying crude oil, 'dirty' product (Condensates and fuel Oil) and 'clean' product (Diesel oil, gas oil, jet fuel, residues and naphtha) for the years 2001 and 2005. This, together with information gathered from ITOPF's database containing tanker spills since that have occurred 1970 can help build up a picture of the risk of spills in the marine environment.

The initial investigation of the tanker route data was undertaken at a global scale. In order to display the tanker voyage data geographically, it had to be transformed from its raw format to a geographically digitised route. During this process the data continued to maintain relevant information such as cargo type, quantity and vessel type. Each route was digitised manually through a set of predetermined waypoints using a variety of information sources to deduce the most likely route taken by each vessel. The tanker voyage dataset for 2001 for example comprised approximately 10,000 individual routes, which upon digitisation became a complex tanker route network. Once the tanker routes were digitised they could then be aggregated in order to calculate the total tonnage and number of vessels along any given section of a route. All information about the voyages is retained down to the individual ports, enabling one to look at regional areas such as Asia and then down to individual countries in greater detail. Figure 4 shows how the geographical information can be built up to show areas where greater risk might occur.

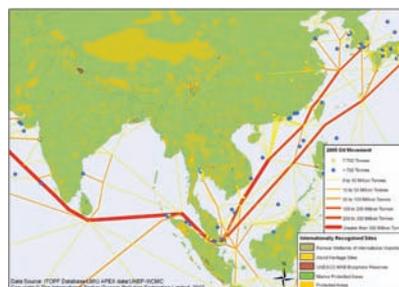


FIGURE 4: GIS INFORMATION FOR ASIA. 2005 OIL MOVEMENTS AND UNEP/WSMC INTERNATIONAL AREAS OF IMPORTANCE

The information shown includes total tanker oil movements, the number, location and size of incidents and also protected areas of international importance.

TANKER TRAFFIC DATA

As both the 2001 and 2005 tanker oil movements were modelled using the same methodology, the difference in movements could be calculated. During the period from 2001 to 2005 oil imports by sea to Chinese ports increased approximately 170% to 140 million tonnes a year. The ports of Ningbo, (the fastest growing port) and Qingdao receive the greatest amount of oil, with an increase of approximately 20 million tonnes between 2001 and 2005.

It should be noted that an increase in tanker traffic does not always equate to an increase in oil movement. Hong Kong has a greater number of vessels docking with approximately 150 more tanker visits in 2005 than in 2001 although in proportion to the port of Ningbo each vessel carries much less tonnage. Figure 5 shows a geographical representation of tanker oil movements and the discharge percentages for the top 10 main Chinese ports, whilst figure 6 shows the location of incidents in relation to the oil movements.



FIGURE 5: GIS REPRESENTATION OF 2005 OIL MOVEMENTS AND IMPORT PERCENTAGES (INCLUDING YANGTZE RIVER)



FIGURE 6: GIS REPRESENTATION OF 2005 OIL MOVEMENTS AND VESSEL INCIDENTS (1970-2007)

ITOPF attends many incidents resulting from both tankers and non-tankers. The numbers of incidents involving non-tanker each year has increased since 2001. From 2001 to 2007 on a worldwide basis there were 62% more tanker incidents than the previous 7 years. However, the ratio of tanker to non-tanker incidents attended by ITOPF has also risen to approximately 50/50. It should be noted that ITOPF does not attend all incidents and therefore the analysis does not take into account of those not attended.

RISK IN CHINA

With an increased need of oil to fuel the thriving industry and consumer demand, projects have been developed to accommodate the need for a greater number of larger vessels. With greater numbers of container vessels arriving and departing the area, Chinese ports are expanding to meet both the increase in traffic and the larger,

newer vessels. From Lloyds Register Fairplay we can see a trend emerging where there is both a steady increase in the number of container vessels and the gross tonnage of each. (See figure 7).

The Yangtze River is the world's third longest river with traffic levels growing at a rate of more than 25% a year. Volumes of cargo have more than doubled between 2001 and 2005 to 795 million tonnes (9). Significant investment is being made on building new ports and developing and expanding current ones. A major project recently begun includes a 53 berth container terminal in Hangzhou Bay just south of Shanghai. Land reclamation is required to support such a large development and a 32km bridge is being built to connect the islands and accommodate auxiliary facilities (10).

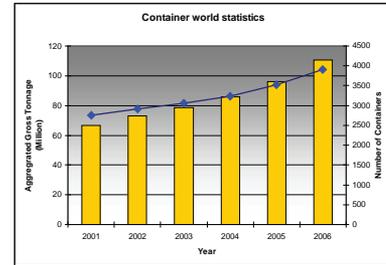


FIGURE 7: CONTAINER STATISTICS FROM 2006 WORLD FLEET STATISTICS, LLOYDS REGISTER FAIRPLAY

With such rapid development, there is the potential for nautical charts to become out of date, potentially increasing the risk of vessels groundings. Statistics from the ITOPF database show that whereas collisions and groundings only account for 22% of incidents worldwide, for tanker spills in China this increases to 48%, (see figures 8 & 9).

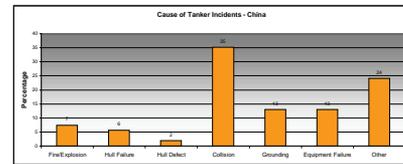


FIGURE 8: CAUSE OF TANKER INCIDENTS IN CHINA (ITOPF TANKER SPILLS DATABASE 1970-2007)

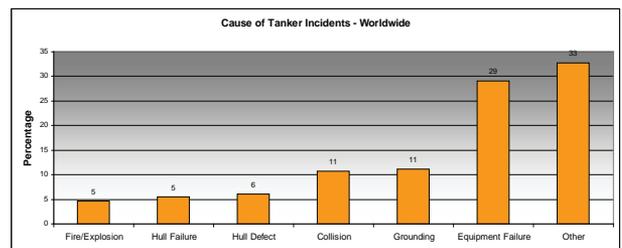


FIGURE 9: CAUSE OF TANKER INCIDENTS WORLDWIDE (ITOPF TANKER SPILLS DATABASE 1970-2007)

FISHERIES

Experience has shown that spills caused by groundings and collisions tend to occur in shallow waters around headlands and in straits where shipping is concentrated. Such waters also tend to be favourable for fisheries and mariculture since they can provide desired characteristics such as shelter from wave action, accessibility and good quality water (11). The coastline of China is characterised by rich fishing grounds and mariculture resources.

The historical coexistence of commercial ports and fisheries in China is still apparent although this is slowly changing. Any spills occurring in such an area are likely cause an impact on seafood production and therefore the economy.

The damage caused by oil spills to fisheries can be categorised into three areas: contamination of fishing and cultivation equipment, direct biological effect and non-direct effects leading to consequential losses and loss of income. Harnessing marine research capabilities to support the investigation of pollution damage is a key issue in promoting a fair and quick resolution of compensation claims in accordance with international regimes such as the international Civil Liability Convention ratified by China.

MARINE POLLUTION PREPARATION

In early December 2005, three international oil and shipping organisations, OCIMF, ITOFF and Intertanko held a series of meetings in Shanghai including a one-day seminar on Tanker Safety, Pollution Prevention and Spill Preparedness. The seminar was attended by about 120 people representing central and local government, oil companies, shipping companies, P&I Club correspondents, law firms, salvage companies, oil spill clean-up companies, environmental groups and academic institutions. This meeting was just part of an initiative to build on international experience to enhance the understanding of and preparation for responding to marine spills.

Both China and regional bodies have been working towards preparing for future marine pollution events. One example is the action plan for the protection, management and development of the marine environment of the Northwest Pacific region (NOWPAP) which was adopted in 1994 as part of the regional seas programme of the United Nations Environmental Program (UNEP). China is one of the members in the Northwest Pacific region; other countries are Democratic People's Republic of Korea, Japan, Republic of Korea and the Russian Federation. Since its creation NOWPAP has established 4 regional centres, Special Monitoring and Coastal environmental assessment (CEARC), Data and Information Network (DINRAC), Marine environmental emergency preparedness (MERRAC) and the pollution monitoring regional activity centre (POMRAC) with each of these centres located in different countries. In 2005 the coverage of the contingency plan was extended to cover the areas of production and transportation of oil and gas along the Sakhalin Island, this resulted in the first exercise in this area to be carried out in 2006 to test the preparedness of NOWPAP member states to accidental oil spills.

The NOWPAP plan applies when one or more of the NOWPAP members are affected or likely to be affected by marine pollution, or when the incident is of such significance that assistance from one or more of the NOWPAP requested. The People's Republic of China also signed up to the International Convention on Oil Pollution Preparedness, Response and Cooperation, 1990 (OPRC) on June 30th 1998. China is however not yet a signatory state to the HNS Convention nor to the OPRC HNS Protocol (12).

NOWPAP has run a number of workshops, meetings and symposiums. One of the programmes under NOWPAP is the Marine Environmental Emergency Preparedness and Response Regional Activity Centre (MERRAC). The aim of this is to develop effective measures for regional cooperation in marine pollution prevention and response in the Northwest Pacific region. MERRAC has published technical reports on sensitivity mapping; guidelines for the use of dispersants and guidelines for shore-line clean up (14).

In recent years the NOWPAP contingency plan has been revised to take into account the need for preparedness for pollution incidents occurring with hazardous and noxious substances involved.

By the end of 2006 there was enough response resources available along the major coastal ports for 260,000 metres of boom,

301 skimmer sets, 520 tons of sorbent and 260 ton of dispersant to cover the 32,000km of coastline. At the time of writing this paper the exact location of this equipment is not known.(13) The MSA has developed a five tier contingency planned response which covers different levels of response from the top state level, region, province, port and individual vessels. A number of oil spill emergency centres (Yantai and Qinhuangdao) have help several oil spill drives.

CONCLUSION

There is no clear quantitative relationship between the volume of oil transported and the risk of a spill, however when combined with local navigation hazards such as traffic density, weather/sea conditions, visibility, water depth, and the nature of the sea bed a picture of the potential risk of spills develops.

Risk is often described as:

$$\text{Risk} = \text{Frequency} \times \text{Consequence}$$

This paper has highlighted the increase in vessel traffic as one factor likely to increase the frequency of spills and with the proximity of the major shipping routes to heavily exploited fishery resources, the consequences of an incident can sometimes be severe affecting both the fishery sector economy and the communities that rely upon it for their livelihood. Both the levels and new advancements of response equipment need to continue being monitored as the grown is vessel movements increase to ensure the effectiveness of the stockpiles.

China's demand for oil imports is increasing and it has been shown that countries who import oil tend to be at a greater risk than those that are major exporters (15). Fortunately to date, oil spills in Chinese waters have been relatively small. With NOWPAP and other organisations working both locally and internationally towards preparing for potential incidents, hopefully the impact from any future marine oil spill can be minimised.

BIOGRAPHY

Lisa Woolgar has a physics degree and was previously employed as a research scientist in a physical oceanography centre also at a defence technology company working on their satellite programme and information mapping service. She joined ITOFF in August 2006 and in conjunction with providing technical support for advisors out on oil spills world-wide, she is responsible for maintaining and developing ITOFF's Geographic Information System which includes an online mapping element.

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