People are sometimes aware of marine accidents, as ship groundings often makes headlines along with the accompanying oil spills and other unfortunate stories. While grounding accidents contribute to approximately one third of marine accidents around the world, the dominant accident type in ports is collision. By focusing on marine accidents in ports, a clear picture about marine accidents can be gathered.

The world’s busiest ports face a potential risk from marine traffic accidents. However, marine traffic centres can often only play an advisory role, and may not be able to satisfy the increasing demand of traffic control within congested port waters. Figure 1 below shows the busiest ports in the world in terms of ship arrivals, with Hong Kong port the second busiest one.

**Port traffic systems**

Marine traffic in ports is very different from that in the open seas. In a port traffic system, most ships travel along fairways and are required to keep a reasonable safe clearance from other ships, coastal structures, and shallow waters. Moreover, marine accident distribution in ports is very different from that in open seas. A port traffic system often involves a large number of ships and their movements, and inevitably traffic related accidents ie. collisions, contacts and groundings. Generally, collisions and contacts are the major cause of accidents in ports, while groundings are more common in open waters. Other marine accidents eg. fire, are related more to ship management.

Imagine a port traffic system as a network of nodes and links. Within the traffic network, each link denotes a section of fairway, and a node a port facility eg. berths, terminals, anchorages or a junction with another fairway and port entry. A route of marine traffic can be represented by a path in the traffic network. Collision accidents result from three types of encounters: crossing encounters are usually found when two ships are navigating towards the same node (junction) along different links; head-on encounters and take-over encounters are commonly observed when two vessels are navigating along the same link.

**Reported accident rates**

Figure 2 below illustrates the number of reported accidents in Hong Kong between 1984 and 2011. The marine accidents are grouped into three types: collision/contact; grounding/stranding; and non-impact. This grouping is proposed because it is assumed that accidents resulting in collision and grounding are associated more with the quality of the traffic system (for example, vessel traffic system, navigation aids, traffic volume) than with the quality of individual vessels. In contrast, non-impact accidents are related to the condition of individual vessels (eg. management and vessel quality). Approximately 69 percent of accidents in each year of the period 1984–2011 were collisions, 8 percent were groundings and 23 percent were non-impacts.

Figures 3 and 4 below represent the reported human toll from accidents for the period 1984 to 2011. It can be seen that both the numbers of fatalities and injuries vary. The number of injuries increases, which mirrors the trend of increased vessel size, given that the number of accidents remain more or less the same. However, it is commonly believed that the consequences of the impact-type accidents that do occur will be more serious than previously, as a result of the general increase in vessel size and its resulting impact force during collisions or groundings.

**Examining the trends**

It is apparent that the ratio of reported collisions (and contacts) has remained approximately constant over the two decades. It is instructive to review the reported accident level with respect to the number of ship visits to the port over a long time span. From Figure 5 below, it can be seen that accident frequency versus ship visits is on a consistent downward trend, reflecting general improvements in shipping management and operation. It is apparent that the safety regime in Hong Kong port has improved over the last two decades with an accident rate approximately half that of 20 years ago. The principal driver behind the improvements in accident occurrence is the action of policy makers (such as the Marine Department and the International Maritime Organisation) in improving the safety of the traffic system. Improved vessel traffic systems eg. automatic identification systems (AIS), navigation aids, ship specifications and training requirements eg. ISM code have also all reduced accident rates. The improvements made in the port traffic risks are a credit to the vigilance of local and international authorities.

**More detailed examination**

In order to have some idea about the learning curve effect over a long period, a simple exponential reduction function is used to describe the general trend. The exponential reduction model assumes the ratio of port accidents to port traffic should contribute to approximately one third of marine accidents around the world, the dominant accident type in ports is collision. By focusing on marine accidents in ports, a clear picture about marine accidents can be gathered.

The model further quantifies that it takes about half-life T1/2 for the accident ratio to fall to one half of its initial value.

\[ T_{1/2} = \ln 2 \div a \]

\[ a = 0.0576 \]

\[ T_{1/2} = \frac{\ln 2}{0.0576} = 12.0 \text{ years} \]

This means that the port safety improves in the last decade when the accident occurrence rate falls by 50 percent in approximately 12 years.

\[ N(t) = N_0 \exp(-at) \]

where \( t \) is time, and \( a \) is the learning rate parameter. The improvement of port safety is a societal process of learning and is the result of collective learning events.
Conclusion

Many concerns regarding marine traffic have arisen in ports, including the increased size of ships and greater traffic amount. Today, busy ports like Singapore and Hong Kong are faced with traffic congestion and delays to maintain the permissible safety level of marine traffic. Many ports will face similar problems soon. The improvement of port traffic safety is an ongoing process, and it is important that the local port traffic issues are effectively addressed.

Data sources: Hong Kong Marine Department, and Hong Kong Port Development Council

FURTHER READINGS:

ABOUT THE AUTHOR
Tsz Leung Yip is associate director of C. Y. Tung International Centre for Maritime Studies at the Hong Kong Polytechnic University. Dr Yip’s interests include the marine traffic, port and terminal logistics and commercial shipping with risk analysis.

ABOUT THE ORGANISATION
C. Y. Tung International Centre for Maritime Studies is a reputed world centre engaged in education and research of logistics and maritime studies. The centre continues to promote academics and industrial collaboration and forge partnerships to benefit the logistics and maritime sector.

ENQUIRIES
C.Y. Tung International Centre for Maritime Studies, Department of Logistics and Maritime Studies, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong. Web: www.icms.polyu.edu.hk Email: cyt.icms@polyu.edu.hk