World Maritime Day 1999

IMO and the New Millennium

As the world approaches the end of the Second Millennium the temptation to look back on the past is as strong as the desire to look forward to the future. Either way, the strongest impression is one of accelerating change. By the end of the 19th century, most of the world's ships were still powered by sailing - just as they had been a thousand years before. Radio had just been invented, but existed on only a handful of ships: even electricity was a rarity. Most of the powered ships that did exist were steamers fuelled by coal. Oil, diesel and turbine engines were still in their infancy.

During the remaining hundred years of the Millennium, shipping, like almost everything else, was revolutionised. Sail gave way to steam, and then coal gave way to oil. Radio became commonplace, then mandatory. Radar was invented, communications satellites were launched Ships grew bigger and faster. Transatlantic passenger liners became the largest, most powerful and most glamorous structures ever built - until their passengers switched to aircraft, which had not even been invented when the century began.

New types of ships were invented to carry oil and dry bulk cargoes in quantities that could not have been imagined a few decades before. Container ships and roll-on roll-off ships not only speeded up trade - they also helped spell the end of many of the world's most famous ports as new docks were developed downstream, on greenfield sites far away from the congestion and constrictions of the cities they helped to create. New shipping nations emerged as traditional ones declined. The industry, which had always been international, became more and more fragmented.

Halfway through the century (in 1948 to be precise) the International Maritime Organization was created. Its chief mandate was to improve the safety of international shipping by acting as a forum where legal treaties and technical measures could be formulated and adopted. In the half century that followed, IMO developed more than 40 conventions and codes and was made responsible not only for maritime safety but also for pollution prevention, liability and compensation and other issues. Its Membership grew from 32 in 1959 to 157 in 1999. Half of those Member States did not exist when the Organization was created.

The current Millennium is ending in a period of often bewildering technological upheaval accompanied by political and economic transformation. But what will the next one bring?

The shape of things to come...perhaps

It seems certain that the revolution in technology will continue. It will probably accelerate, so that the world in 2099 will be even more different from today than today is from 1899.

Some of the changes that *might* take place are suggested below. It is probable that some of them will occur, although it is more likely that most of them will not. But all of them could one day soon become technically possible.

In general, the technology revolution will be beneficial to shipping and those associated with the industry. Perhaps the greatest change of the last century has been in the field of communication. Although radio was first used to carry out a rescue at sea in 1899, the medium was still in its infancy. When most ships left port in 1899, they were virtually cut off from the rest of the world until they reached their destination. Today ships are linked by radio to their owners and others on shore and other ships at sea, their position can be pinpointed through Global Positioning Systems (GPS), their course can be tracked by radar and, in the event of an emergency, their position can be automatically transmitted to rescue authorities on shore. Communications will continue to improve into the foreseeable future - and costs will continue to fall.

Shipmasters will be able to participate in video conferences with their company and others. Seafarers and passengers will be able to watch their favourite television programmes, even if they are 10,000 miles from home, and will be able to talk to and see their families via video telephones. If an accident does happen (and they will become less and less frequent as the new Millennium advances), the search and rescue response will be almost immediate and will usually be successful. Advances in meteorology will make weather forecasting ever more accurate, so that ships will be able to dodge dangerous storms. The days when a ship can disappear without trace will come to an end.

Ships themselves will continue to develop. At present there is considerable interest in high-speed craft, especially on short-sea passenger routes. Where 25 knots was once regarded as fast, some new designs are capable of 60 knots and before long the 100 knot barrier will be broken. Extra speed will enable HSC to compete more effectively with airlines and other forms of transport, thereby winning back passengers.

The development of "wing-in-ground" effect craft will see speeds increase even further. The line between ships and aircraft will become more and more blurred and IMO and the International Civil Aviation Organization (ICAO), which are already co-operating on developments in this area, will set up a permanent Secretariat to regulate the safety of craft which can float, fly and, if necessary, travel by land as well.

At the same time, the current boom in cruise shipping will continue for as long as the economy of the world continues to flourish and its population continues to age. The ships themselves will become larger and more luxurious.

The equipment used on ships will become more sophisticated. It is already possible to install systems on ships that enable their position to be determined to within a few metres. This accuracy will improve - and the cost of the equipment will go down until it is cheap enough to install on small coasters, fishing boats and pleasure craft. Electronic charts will also become so cheap and user-friendly that eventually conventional paper charts will no longer be required. Magnetic compasses will join them as museum items, on the grounds that the tendency of the magnetic North Pole to wander around the geographical pole makes it too unreliable to continue to serve as a direction-finding device.

Deck officers will still be taught how to navigate by traditional methods - but in practice they will rely on electronic means, using satellite communications because it will be quicker and more accurate. Global positioning systems will be combined with electronic charts to enable ships to change course automatically, avoiding shallows, reefs and other navigational hazards and always observing traffic separation schemes and other routeing systems.

Shipowners, aware that most accidents at sea are caused by human error, will endeavour to dispense with the humans who make the errors and contribute an excessive amount to operating costs. Will robot ships become common, directed from the shore by managers and computer experts?

Disputes will develop over who is responsible for ships operating within mandatory routeing systems: the operators of the routeing system and the shipowners who use it will both try to pass responsibility (and hence liability) to the other. After a major collision, IMO will be called upon to develop a convention.

As oil deposits run out during the course of the century, other sources of energy will be developed, including wind and wave power. The marine environment will improve as the world oil tanker fleet dwindles, but the rapid development of hundreds of kilometres of wave-energy plants and thousands of offshore windmills will cause environmental hazards in many areas. Nuclear-powered merchant ships will make a comeback.

In 2099 small groups of former seafarers will gather in ports around the world and reminisce about the good old days. They will grow misty-eyed about the joys of bulk carrier terminals and tell their friends of turn-rounds in container ports that sometimes lasted several hours. They will tell each other horror stories about ships without stabilisers and the misery of not being able to watch soap operas in the South Pacific because of reception difficulties. They will complain about the lack of reception facilities for ships' wastes. They will agree that the younger generation has no idea what true seafaring is all about and, since most of the world's seafarers by then will be women, they will also sadly agree that seafaring has nothing to offer the young girl of the future.

Technology: the only constant will be change

As the previous section has tried to demonstrate, predicting the future is not an exact science. Some guesses will be more accurate than others. It seems likely, for example, that shipping will still be important in the next Millennium, because it has proved itself to be the most economic way of shifting large quantities of goods across the ocean. As long as international trade exists, ships will continue to have a place.

It also seems probable that alternative power sources will have to be found, because at some stage the supply of carbon-based fuels will run out. Oil, which now powers most of the world fleet, will become too expensive to use. Finding a suitable replacement will become one of the most important missions of the next hundred years (let alone the next thousand) for humanity as a whole rather than shipping as an industry. But some of the ideas that are currently being considered, such as wave and geothermal power or hydroelectricity are not going to be practical for ships. Cleaner fuels derived from sugar (already being used in some countries) could catch on. Coal could make a return (if environmental objections can be overcome) before that, too, runs out. There might even be a second chance for nuclear power. Wind-power and solar power might also prove useful in some cases.

IMO's task will be to ensure that whatever changes are made will be safe and environmentally sound. This is easier said than done: if IMO adopts regulations that are too strict, then the development of valid and useful technology will be inhibited or even prevented altogether. If the regulations are not strict enough, then the results could be disastrous.

One of the difficulties with introducing new technology is that the advantages are so tempting, from the commercial point of view, that the potential drawbacks are sometimes not properly assessed. In the late 1960s, for example, a number of oil tankers suffered from explosions during tank cleaning operations. Subsequent investigations found that these were caused by static electricity generated by the tank cleaning process. Although the oil in the tank had been pumped out, the tanks still contained explosive gas. The solution was to make it mandatory for oil tankers to be fitted with an inert gas system, which involved filling the cargo tanks with non-explosive gas from the ship's exhaust system. This enabled tank cleaning to be carried out safely, without the fear of an electrical spark leading to disaster.

In 1967 the tanker **Torrey Canyon** ran aground off the west coast of England, resulting in the world's first major oil pollution disaster. One of the most striking features of the incident was the virtually complete failure of measures to contain the spill and then to clean up the pollution that resulted. Some of the measures taken may even have made matters worse.

The reason was that although the shipping industry and Governments were aware of the fact that oil tankers were growing bigger to take advantage of the economies of scale presented, no one had given serious consideration to what would happen if something went wrong.

The development of the roll on/roll off ship could be seen as another example of the benefits of a new idea being so great that the possible disadvantages were not properly taken into account. The hulls of conventional ships are divided into watertight compartments, the idea being that the bulkheads between them will either prevent the ship from sinking, or will at least enable it to survive long enough for those on board to evacuate it safely. A ro-ro ship, however, has doors opening on to a completely open deck. If water gets on to the car deck in sufficient quantities the stability of the ship can be so impaired that the ship will not only sink very quickly but also will probably capsize.

Despite this, the ro-ro design proved to be an outstanding commercial success and the potential dangers were glossed over. Over the years measures were introduced to improve cargo safety but with hindsight one can see that very little was done to solve the crucial problem of what would happen to a ro-ro if water got on to the car deck. Then, in March 1987, the **Herald of Free Enterprise** sank and 193 people died.

As a result of this tragedy, caused by water pouring on to the car deck when the bow door was left open, further measures were introduced, including an improved stability standard that became known as SOLAS 90 (it was actually inspired not by the sinking of the **Herald of Free Enterprise** but that of another ro-ro called the **European Gateway** in 1982). The new standard was approved for new ships, but attempts to extend it to existing ships under a ten-year phase-in period were turned down and a modified, less costly alternative was adopted. Then in 1994 the ferry **Estonia** capsized in the Baltic. Further measures were introduced and this time the SOLAS 90 standard was accepted. For ships operating in north-western Europe, SOLAS 90 also has to take into account the presence of 0.5 metres of water on the vehicle deck. This proposal, however, was only accepted by a number of countries in north western Europe. Elsewhere the existing standard was maintained.

There is no doubt that many of IMO's most important initiatives have been prompted by disasters. The **Torrey Canyon** led to several conventions dealing with legal issues, including liability and compensation as well as the International Convention for the Prevention of Pollution from Ships (MARPOL), 1973. A series of tanker accidents off the coast of the United States led to the adoption of the 1978 Protocols to MARPOL and to the International Convention for the Safety of Life at Sea, 1974 (SOLAS). Ro-ro safety would not have been improved to the extent that it has without the shocks of the **Herald of Free Enterprise** and the **Estonia.** A series of bulk carriers sinking in the early 1990s led to a sustained effort by IMO to improve the safety of this type of ship, which at one stage was sinking at the rate of almost one every two weeks. Important improvements have been made to the fire safety of passenger ships, following various incidents including the **Scandinavian Star** disaster of 1988 in which 165 people died.

One reason for this is that, until something goes wrong, the general public and most politicians are not aware that there is a problem. The need for change is not apparent and so things are allowed to stay the same. When a disaster does occur the shock is therefore considerable and the public demands an instant response. The Secretary-General of IMO, Mr. William A. O'Neil, said in a speech to the general council of the Baltic and International Maritime Council in May 1999: "Public opinion forces governments into action and it is impossible to avoid this reaction. How could the British or Swedish authorities hope to convince the public that ro-ros were safe when the **Herald of Free Enterprise** and **Estonia** had just sunk? How could the United States tell people that tankers

were good for them when their television screens were filled with images of the **Exxon Valdez** surrounded by dead sea birds covered in oil?"

Decisions made in such circumstances are not always the best. In the same speech Mr. O'Neil said: "There is no doubt that some of the legislation which was developed in the past was prompted by political rather than technical considerations. Some of it may even have been marginally necessary and it is not surprising that one of the complaints that is heard about IMO is that it is introducing new regulations at too rapid a rate."

There are a number of developments in shipping today which have caused concern. One is the trend towards speed. Twenty years ago 20 knots was considered fast, but some ships today can operate at three times that speed. It seems likely that the 100-knot barrier will be broken before long. But how safe are such ships likely to be - and what would be the consequences if, for example, a passenger ferry travelling at 80 knots were to collide with another ship?

The first major attempt to deal with high-speed craft was made in 1977, when the IMO Assembly adopted the Code of Safety for Dynamically Supported Craft (DSC), which included hydrofoils and air-cushion vehicles such as hovercraft. It was not a mandatory instrument, but was designed to be used by shipbuilders and administrations when such craft were developed. The preamble to the Code states: "Over a period of some 30 years, new designs of marine vehicles, some of which are amphibious, have been developed, and while these cannot fully comply with the provisions of the international conventions relating to passenger ships, they have demonstrated an ability to operate at an acceptable level of safety when engaged on restricted voyages under restricted operational weather conditions and with approved maintenance and supervision schedules."

By the 1990s, the DSC Code was becoming out of date and in 1994 IMO adopted a new International Code of Safety for High-Speed Craft (HSC) which was later made mandatory through amendments to SOLAS which entered into force on 1 January 1996. The Code covers the craft that were covered by the original DSC Code, but it also recognizes the further development of craft that are much larger and operate over much longer distances.

Yet almost before the HSC Code had entered into force as a mandatory instrument it was clear that it was no longer suitable for some of the designs that were being put forward. It was decided, therefore, that it would have to be amended. IMO has now agreed to develop a new edition relating to new high-speed craft and to apply the existing code to existing craft.

A number of draft amendments have already been prepared which are intended to bring it into line with amendments to SOLAS and new recommendations that have been adopted in the past four years - for example, requirements covering public address systems and helicopter pick-up areas.

If it is difficult keeping pace with HSC, the development of wing-in-ground (WIG) craft, which skim the surface of sea at very high speeds and in some cases have the ability to take off and fly as well has presented even bigger problems. IMO is also developing a Code of safety for WIG craft, which is derived from the HSC Code.

At the same time, the WIG craft can fly and therefore appropriate provisions of the International Civil Aviation Organization (ICAO) will also be incorporated. An article in the shipping magazine *Fairplay Solutions* in January 1999 commented on the possible safety hazards of high speed craft and wondered if the high speeds which can now be achieved meant that passengers would be expected to wear seatbelts and would not be able to walk around, because of the danger of a collision. It concluded: "The modern fast ferry has more in common with an aircraft than a ship."

It is not always new technology that causes problems. When a tanker or bulk carrier unloads its cargo and embarks on the return voyage, it may have to take on ballast water to ensure that the

ship is stable and that the rudder and propeller are immersed. This is a tried and tested practice which, from a safety point of view, has worked well since it was first introduced in the 1880s. Yet in the process marine life forms have been transported from one place to another. The problem was first identified in 1903 but it was not until the 1980s that the extent of the danger to the environment was fully recognized. It has been estimated that ballast water may be carrying 3,000 species of animals and plants a day around the world. IMO is now working on counter-measures which could take the form of a new convention or a protocol or annex to MARPOL 73/78.

Containers have also been used on ships for many years, since being developed in the 1950s. The ships on which they are carried have increased steadily in size and some can now carry 6,000 twenty-foot long units - enough, it has been claimed, to create a line of trucks and lorries 150 kilometres long. But has safety always been treated as a priority?

In December 1998 the MSC was sufficiently concerned to issue a circular on the subject. It "expressed serious concern at the dangers to personnel working at the top of containers during container securing operations, which result from container-securing arrangements being located in difficult and dangerous locations". The annex to the circular contained a number of recommendations on safety of personnel during container-securing operations. The introduction states:

"It has been noted that a number of fatal accidents to crew and dockworkers have involved falls from the top of containers during container-securing and unsecuring operations. Although fall protection and fall arrest systems and equipment are available for use whenever container top work is involved, they are cumbersome and reduce the speed of loading and unloading operations of a ship, and are thus of limited use and effect."

"The conventional means of securing containers in non-cellular deck spaces are heavy and difficult to handle, resulting in accidents and non-fatal physical injuries. Newly developed equipment such as semi-automatic and dual-function twistlocks are only partially effective in eliminating danger. They depend on the stacking height of containers on deck not exceeding four and require a safe work place on the quayside for their application or removal."

"A safer environment for personnel involved in the securing of containers can be achieved by shipowners and ship designers focusing on the safety of container securement at the initial stages of the building of a ship, rather than relying on operational methods for this purpose after the ship is built."

An article in *Seaways*, the magazine of the Nautical Institute, in May 1999 said: "A number of disturbing incidents in recent years indicate that containerships may now be designed beyond safe limits." It claimed that the hull size of containerships was being kept deliberately low to minimize harbour dues and other costs. The International Convention on Tonnage Measurement of Ships, 1969 does not take deck cargoes into account and on some modern containerships up to 73% of the cargo is now carried on deck.

As a result, containers are exposed to sea and bad weather; the stacks are so high the containers cannot be secured properly and the ship can become unmanoeuvrable at low speeds, due to strong winds; visibility from the bridge is restricted; and the high position of the bridge means that ship movement causes more fatigue.

The head of safety and emergency services at a port in the United Kingdom was quoted as saying: "It sometimes appears to me when I visit container ships that the ship designer has put much thought into designing a beautiful vessel up to the deckline and then entirely forgotten that approximately 50% of the vessel's cargo is built above that line where design ceases."

Another sector of the shipping industry that is currently doing well is cruise shipping. According to statistics issued by the International Council for Cruise Lines (ICCL), the cruise line business contributed $11.6 billion to the economy of the United States (the centre of the world cruise industry) in 1997 and this figure could rise to $18.3 billion by 2002. New ships are continually being ordered and some of these currently planned can accommodate 6,000 passengers and crew - equivalent to a small town. Over the years, the requirements of Chapter III of SOLAS, which deals with life-saving appliances and arrangements, have been repeatedly updated, but nevertheless there is still some concern about how such large numbers could be saved in the event of an emergency.

The Secretary-General told a conference held in September last year in Hamburg: "According to SOLAS, life-saving appliances should be capable of being launched within 30 minutes. Can we guarantee that this will apply on the new cruise ships that have 5,000 people or more on board?

"And even if they are all safely evacuated, how will they be rescued? Survival may ultimately depend on how quickly other ships can reach the scene of the accident. How many ships would be required to save 5,000 people? How many ships today have equipment that can pick shipwrecked survivors out of the water - at night and perhaps in stormy conditions?"

In December 1998, *Seaways,* the magazine of the Nautical Institute, published a letter from a cruise ship captain in which he said: "The thought of having to evacuate a considerable number of 'souls' into lifeboats and liferafts in rough weather is alarming. No matter how good our training, I have an uneasy feeling that should the vessel have to be evacuated in rough weather there will be boats and rafts put out of action." This problem could become worse as the next Millennium develops. In 1997, 20% of the population of the United Kingdom were over 60 years of age; by 2010 the total will be 25% and by 2025 it will reach 33%. Many will choose to spend some of their leisure time by going on a cruise. Since elderly people are always more at risk in an emergency than young ones, it is imperative that their safety is properly taken into account. Some cruise line operators are targeting customers with young families - which means that special care has to be taken to ensure the safety of children.

Technical change is generally prompted by commercial considerations. A new idea promises some sort of commercial reward and, as the examples above show, the safety and environmental issues have not always been fully explored. The idea that IMO and the industry should wait for the inevitable disaster before taking action is clearly unacceptable. But the problem that needs to be solved very quickly is how to ensure that the advantages offered by new technology are introduced quickly - and at the same time safely.

Why don't we learn from history?

The need for the shipping industry to learn from its mistakes has always been recognized by IMO. The first convention to be adopted by IMO after it came into being in 1959 was the 1960 version of SOLAS. Regulation 21 of Chapter I states: "Each Administration undertakes to conduct an investigation of any casualty occurring to any of its ships subject to the provisions of the present Convention when it judges that such an investigation may assist in determining what changes in the present Regulations might be desirable." The same text appears in the 1974 version.

The purpose of this regulation is to make sure that accidents do not happen twice. In theory, the accident investigation will establish the cause and IMO can then change the regulations accordingly. In practice, very few reports into serious casualties are sent to IMO each year.

One reason for this might be the traditional secrecy of the shipping industry and the fear that by disclosing information about casualties, owners might be providing valuable information that could be used by their competitors - or might be used against them in a dispute over liability and compensation. In April 1998, the International Association of Independent Tanker Owners

(INTERTANKO) prepared a discussion paper entitled *Systematic approaches to tanker accident analysis - lessons learnt.*

The paper tells how, 15 years before, INTERTANKO made concerted efforts to find remedies to rectify an increasing number of tanker accidents caused by fires and explosions. The response from shipowners, underwriters, cargo interests and flag States was disappointing: they all showed "unwillingness to reveal facts." The reason, INTERTANKO said, "may largely stem from legal difficulties involved in the release of information, particularly where such information might reveal negligence or liability by the parties concerned." Despite assurances that information would be treated in confidence, INTERTANKO found that "shipowners demonstrated reluctance to divulge information before such time as all legal formalities had been completed, or a legal settlement had been finalized."

The INTERTANKO paper states: "Not much has changed over the last ten years to correct the current lack of transparency existing in accident investigations. When errors are made, it is human nature that individuals try to protect their own integrity, as incidents causing damage can lead to legal liability and even accusation of a criminal offence. The real causes of accidents may not be revealed and new legislation may therefore be passed for the wrong reasons."

The irony is that there is a great deal of information available within the industry that could be used to carry out a proper analysis of accidents and their causes, enabling effective counter measures to be adopted without the imperative of a major disaster acting as the spur. The inquiry into the **Estonia** disaster revealed that between 1975 and 1986 there had been at least 16 incidents involving bow door defects on Finnish and Swedish ro-ro ships (the **Estonia** sank because the bow door was ripped off in heavy seas). Had this information been made generally available it is possible that some action could have been taken in time to save the **Estonia** and the 850 passengers who died. The shipping writer Michael Grey commented in *Lloyd's List*: "Were owners of ex-Baltic boats working in the Mediterranean or Far East ever told of the problems that were experienced by the operators of the **Finlandia** or **Viking Saga,** of the fright that the watchkeeper of **Wellamo** received when he saw the bow visor lifting as he ran down from Helsinki to Stockholm in a storm one night in 1975?"

Apart from shipping companies and port authorities, classification societies possess a huge amount of information and more recently the inspections carried out by port State control bodies have provided another huge database of information that could prove useful to IMO.

It should be possible, by using this information, to ascertain not just which ships or types of ship are a safety hazard, but what problems individual ship types are likely to encounter. An analysis of collision statistics, for example, could reveal which impacts are most dangerous and which sections of ships are most vulnerable. The information could then be used to improve the design of ships and equipment.

Five years ago IMO tried to establish an International Ship Information Database, which would enable this sort of systematic approach to be carried out. But budgetary constraints meant that the idea had to be abandoned in 1995. Despite this, the Organization still attaches great importance to making better use of casualty statistics. In 1997 the procedures for reporting casualties and incidents contained in SOLAS and the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78) were harmonized. A circular was issued listing casualties according to seriousness (very serious casualties are those which involve total loss of the ship, loss of life or severe pollution) and defining the sort of information that should be provided regarding each incident.

Since then IMO has requested Member States to provide information relating to 2,896 casualties and to date 1,676 reports have been received. The reports have been forwarded to a

permanent correspondence group of the Sub-Committee on Flag States Implementation (FSI) which identifies trends and makes recommendations to relevant IMO bodies. In December 1998 it reported that "full value could not be obtained from many reports due to the lack of information provided. It was evident that no investigation had been undertaken in some cases." Investigators sometimes appear to be hampered by being "deprived of the opportunity of interviewing crews because of issues of blame and liability...Legal intervention in safety investigations is a major problem."

The correspondence group said that many lessons learned from casualties analysed relate to operational and management behaviour. The report says: "The probability of preventing such casualties in future is remote, unless the lessons learned are passed on to seafarers. At present, there seems to be no mechanism for getting the message through to them."

In an attempt to improve the quality of casualty investigations and of information provided to IMO, in 1997 the IMO Assembly adopted a Code for the Investigation of Marine Casualties and Incidents. The introduction to the Code states that its aim is to "promote a common approach to the safety investigation of marine casualties and incidents...the result of this common approach and co-operation will be to aid remedial action and to enhance the safety of seafarers and the protection of the marine environment."

There is certainly scope for a more searching analysis of the reasons why ships sink or have accidents. Each year the International Underwriting Association issues shipping casualty statistics. Total losses are attributed to six different causes: collision or contact, fire or explosion, grounding, machinery, weather or other. Between 1994 and 1998 there were 540 total losses, 153 of which were attributed to weather. Commenting on these figures in the 1999 Lloyd's Register lecture in March 1999 the Secretary-General, Mr. O'Neil, said: "As a professional engineer I find this explanation unacceptable. We do not build bridges expecting that they will collapse if they are exposed to certain weather conditions. Dams are not built so that they will automatically burst when the water level reaches a certain point...ships are not launched with a warning attached saying that they must not be used if the wave height exceeds a certain magnitude, or if a gale reaches a specific force."

Mr. O'Neil said that attributing losses to weather or other causes "can no longer be accepted because it does not get to the root cause of the problem and does not give sufficient recognition to the fact that when ships go down lives are usually lost."

Another generalisation that is frequently quoted is that 80% of accidents at sea are due to human error. The phrase implies that fault lies primarily with the seafarer and that the errors made are due to carelessness. Yet this is not necessarily true. The International Safety Management (ISM) Code was adopted by IMO because experience had shown that many accidents at sea could be attributed not to mistakes made by those on board ship but to decisions made in the boardroom of the shipowner. Other mistakes, it now emerges, can be attributed to bad design.

One of the problems that have been encountered since the introduction of the Global Maritime Distress and Safety System is that of false alerts. While the blame was initially put on seafarers, a recent study by the United States Coast Guard has come to a different conclusion. The Coast Guard carried out a series of tests on DSC radios, which revealed numerous design errors. One model occasionally inserted the wrong identity of the ship into a distress relay message. Three models continued to transmit distress alerts on one DSC channel after an acknowledgement had been received on another channel.

Investigations into shipping accidents have often been hindered by the fact that when a ship sinks it disappears from view. Once it would have been given up as lost forever - but the discovery of the wreck of the bulk carrier **Derbyshire** has changed that. The ship was lost in the Pacific in 1980 and sank so quickly that no distress message was sent. Nearly two decades later, an expedition funded by the International Transport Workers Federation (ITF) found the ship more than two miles

down and further study has produced so much evidence about why the ship sank that the inquiry into the loss has been re-opened. New proposals for improving bulk carrier safety have already been submitted to IMO. The finding of the **Derbyshire** was a triumph of technology and persistence and it showed that, if the determination and resources are there, more or less any shipwreck can be located and analysed to find out what went wrong. As technology improves, such investigations will become more and more common.

The more effective use of casualty investigations and statistics should help accidents at sea to be reduced. Formal safety assessment (FSA) is another promising development. FSA is described as a rational and systematic process for assessing the risks associated with any sphere of activity, and for evaluating the costs and benefits of different options for reducing those risks. It therefore enables an objective assessment to be made of the need for, and content of, safety regulations.

FSA consists of five steps: identification of hazards (a list of all relevant accident scenarios with potential causes and outcomes); assessment of risks (evaluation of risk factors); risk control options (deriving regulatory measures to control and reduce the identified risks); cost benefit assessment (determining cost effectiveness of each risk control option); and recommendations for decision-making (information about the hazards, their associated risks and the cost effectiveness of alternative risk control options is provided). One major advantage of FSA is that it will make sure that safety is taken into account throughout the design and construction process - and not treated as an afterthought as has sometimes been the case in the past.

The MSC and MEPC have approved Interim Guidelines for the Application of Formal Safety Assessment (FSA) to the IMO Rule-Making Process, so that trial applications of FSA can be carried out to assess its worth. In December 1998 the MSC accepted a United Kingdom proposal to carry out a formal safety assessment (FSA) study of bulk carriers, to aid future IMO decision-making on bulk carrier safety.

The FSA study, scheduled to be completed over a two year period by a number of IMO Member States in collaboration with observer organizations will look at a range of measures to improve bulk carrier safety, including problem areas referred to the MSC by the SOLAS Conference of November 1997, which adopted the new Chapter XII to SOLAS on bulk carrier safety.

It seems likely that the use of FSA and similar methods will increase in the years to come. While improved casualty investigations (aided by the fitting of voyage data recorders) may help to stop disasters happening again, FSA might enable them to be prevented in the first place. Model testing and computer analysis is bound to make great strides in the future. One day, perhaps, the world will see the construction of the first truly unsinkable ship - maybe less than a century after the sinking of the **Titanic.**

Putting people first

The impact of technology on the modern world has been so enormous that the role of people has sometimes been overlooked or forgotten. The INTERTANKO paper quoted earlier says: "Some experts believe that while technology is increasing equipment reliability, it is actually reducing the human reliability of its operation ... as control has become more precise, local human intervention has been removed, moving crews to remote control rooms with computer displays."

The old idea that "human error" was simply another term for "carelessness" can no longer be sustained. The evidence suggests that it is in fact an extremely complex subject, with no simple solutions. But a good start would be to consider the people who will serve on the ship when it is being designed. Rear Admiral J. C. Card told the Webb Institute in New York in March 1997: "It is time to consider the human element as the key to the long-term welfare of any ship and design the ship accordingly." He gave as an example of how not to do it the traffic controllers' stations at

Washington National Airport's new terminal, which had to be ripped out and replaced because traffic controllers who were shorter than the average could not see the runway from the station provided.

Such mistakes can be even easier to make in shipping, which is such an international industry. The American Bureau of Shipping, emphasising that design should take into account the people who are going to do the work, issued Guidance Notes on the Application of Ergonomics to Marine Systems 1998 which pointed out that people from different parts of the world are of different heights. The 95th percentile standing height of a north European, for example, is 1880 mm. That of a man from south-east Asia is 1693 mm. The moral is that a dial or control panel that can be easily reached by a Norwegian might be inaccessible to a Filipino.

The correspondence group on casualty statistics reported to the FSI Sub-Committee that many accidents have involved the use of lifeboats. "Inherently complicated equipment continues to lead operators to make mistakes with catastrophic results. It would be interesting to know the proportion of lives saved using lifeboats, compared with the number of injuries and lives lost in operation of launching devices over the last few years."

Because decisions are sometimes made by those on shore without consulting those who serve at sea, responsibility for mistakes can often become blurred. The correspondence group on casualty statistics reported to IMO's FSI sub-Committee that many groundings are due to the lack of adequate charts. The report states: "Although it is the ultimate responsibility of masters to ensure that correct charts are on board, this fact does not absolve companies of their responsibility to facilitate supply. To establish the reason why correct charts are not placed on board, the role of the company should be investigated."

Sometimes the possibility of incurring the displeasure of shore management can influence the actions of sea-going personnel. An inquiry by the Australian Marine Incident Investigation Unit into a fire on board a dredger resulting from an oil leak praised the crew for their firefighting efforts. But it noted that a previous leak had not been dealt with, as it would have involved stopping the dredger for an hour. The chief engineer had been criticized by the company for stopping the ship on an earlier occasion and had been told that stoppages cost Aus$10,000 an hour.

For some time now, the shipping industry has been concerned about the supply of seafarers. The International Shipping Federation says in its 1999 annual report that the "international industry is approaching a critical point regarding manpower supply." In particular, the demand for officers appears to be exceeding supply and this could have implications for the shore-based maritime industries because, as the ISF report points out, "the shore based work force is closely linked to an adequate supply of high calibre seafarers."

Hopes that this imbalance would be resolved were raised in the short term by the Asian economic crisis, which suggested that some former seafarers were going back to sea because of the shortage of jobs ashore. The ISF report comments that "their return is expected to be short-lived once the Asian economies recover."

Even if this is not the case, the shipping industry can hardly take comfort from the implication that people only go to sea (or at least stay there) because they cannot find anything better on shore. Other evidence does indicate that morale of seafarers is not as high as it should be. A survey of life at sea carried out by the ITF in 1998 showed a high level of racism and low pay and there was an indication of a link between hours worked and the levels of accidents on board and a correlation between long hours, stress and poor morale. An ITF official was quoted in Lloyd's List as saying: "The worst type of competition is taking place at the bottom of the shipping market. Owners seem to be fighting to see who can pay the least, work the longest hours and provide the most meagre conditions."

For officers life might be better, but there still appear to be problems. An article in the Nautical Institute's magazine *Seaways* in December 1998 said: "The public image of the shipmaster is appalling. He is assassinated by the media whenever there is an incident and the industry is entirely to blame for this ... no company can go public to back up their masters without committing commercial suicide." As a result, the article said, "there is no doubt that masters feel insecure and vulnerable to summary dismissal without recourse."

This is a far cry indeed from the days when Lloyd's Register of Shipping listed the name of the captain alongside that of the ship, when the power of the captain was so great that he was allowed to marry people on board - and his authority so unquestioned that the captain was usually called the master.

People are so important to the future of the shipping industry, that IMO has adopted numerous regulations, codes and recommendations on the subject. The IMO Assembly in November will consider a draft resolution on the ***Principles of safe manning***. This is intended to replace a resolution adopted in 1981. It includes basic principles to be applied when considering manning levels in order to ensure the safe operation of the ship. It also includes detailed guidelines for the application of principles of safe manning and guidance on contents and a model format of a minimum safe manning document. Each ship should be issued with a "minimum safe manning document", specifying the minimum safe manning levels. The document can then be inspected during port State control.

The Assembly will also be asked to consider proposed amendments to the Code for the Investigation of Marine Casualties and Incidents so that the human element is taken into account. The introduction to the proposed new sections states: "Ships operate in a highly dynamic environment; frequently the people on board follow a set routine of shift work disrupted by arrival at, working in, and sailing from port. This is an existence that involves living in the place of work for prolonged periods creating a unique form of working life, which almost certainly increases the risk of human error.

"Historically, the international maritime community has approached maritime safety from a predominantly technical perspective. The conventional wisdom has been to apply engineering and technological solutions to promote safety and minimize the consequences of marine casualties and incidents. Accordingly, safety standards have primarily addressed ship design and equipment requirements. Despite these technical innovations, significant marine casualties and incidents have continued to occur."

"Analyses of marine casualties and incidents that have occurred over the past 30 years have prompted the international maritime community and the various safety regimes concerned to evolve from an approach which focuses on technical requirements for ship design and equipment to one which seeks to recognize and more fully address the role of human factors in maritime safety within the entire marine industry. These general analyses have indicated, that given the involvement of the human in all aspects of marine endeavours including design, manufacture, management, operations and maintenance, almost all marine casualties and incidents involve human factors."

The introduction goes on to say that one way the maritime community has sought to address the contribution of the human factor to marine casualties and incidents has been to emphasize the proper training and certification of ships' crews. It has become increasingly clear, however, that training is only one aspect of human factors. There are other factors which contribute to marine casualties and incidents which must be understood, investigated and addressed. They include communication, competence, culture, experience, fatigue, health, situational awareness, stress and working conditions.

An important contribution to human error is made by fatigue. IMO adopted resolution A.772(8) *Fatigue factors in manning and safety* in 1993 and work on the subject has continued ever since. In December 1998 the MSC reviewed work carried out by the Joint MSC/(MEPC) Working Group on the Human Element. The Working Group noted that there is a need to: understand the nature of fatigue; identify the extent of the problem; identify the factors that have an influence on fatigue; and develop strategies to manage the problem.

The report points out that fatigue has been recognized around the world as a contributor to many accidents involving means of transport. There have been many incidents where fatigue has been suspected of contributing or causing transportation and industrial accidents; however, that connection was difficult to justify because the vital links between the unsafe acts and decisions which led to the accidents and the fatigue state of the people involved were not made.

The reasons for not making the links have varied. At one time, fatigue was discounted as a potential cause of human error; indeed, a common myth existed that fatigue could be prevented by characteristics of personality, intelligence, education, training, skill, compensation, motivation, physical size, strength, attractiveness, or professionalism. Also, the lack of scientifically accepted information on how fatigue affects not only mood and feelings, but individual and team performance as well constrained investigators and analysts. Further guidance on how to investigate for fatigue and build the links between a person's recent history and potential impairment has been lacking. Unlike alcohol and drugs, which can be measured by, for example, by blood tests, there is no unequivocal physical or chemical test that can tell us that a person was impaired by fatigue.

The MSC established a correspondence group, to be co-ordinated by the United States, which will review how "fatigue" affects maritime safety; and develop strategies to combat it.

What seems certain is that IMO's current concern for the element will continue for many years to come. If it is true that 80% of accidents at sea are caused by human error, then certainly this is the area that needs most attention. It is also apparent that although humans have always been involved in shipping, there is still a vast amount to be learned about them and the reasons why they make mistakes.

Immediate priorities

IMO's immediate programme of action in the new Millennium is likely to be established by a draft resolution entitled 'Objectives of the Organization in the 2000s'. The Assembly will consider this for adoption in November 1999. The draft resolution stresses the importance of implementation and refers to two resolutions previously adopted by the Assembly. In 1981 resolution A.500 (XII) defined the objectives of IMO for the 1980s and referred to the fact that "time is needed for maritime administrations to formulate national rules and regulations for effective implementation of IMO conventions". In 1993 the Assembly adopted resolution A.777 (18) which also referred to the need for better implementation and directed IMO Committees to review their work methods and organization of work.

The draft resolution calls on IMO's committees:

.1 to take measures to implement the proactive policy agreed in the 1990s more actively than in the past, so that trends which might adversely affect the safety of ships and those on board and/or the environment may be identified at the earliest feasible stage and action taken to avoid or mitigate such effects. In implementing this directive, Formal Safety Assessment should be used to the extent possible in any rule-making process;

.2 to focus their attention on:

-shifting emphasis on to people;

-ensuring the effective implementation of existing IMO standards and regulations relating to maritime safety and environmental protection, placing particular emphasis on the implementation of the revised STCW Convention and the ISM Code and putting in place the necessary infrastructure for the implementation of the global SAR plan and the MARPOL requirements concerning oil reception facilities;

-addressing safety and environmental protection issues, to the extent feasible, by ship types, with particular emphasis on passenger ships (including high-speed passenger craft) and bulk carriers;

-ensuring the wide early acceptance of those Annexes to the MARPOL Convention which have not yet entered into force;

-developing a safety culture and environmental conscience in all activities undertaken by the Organization;

- avoiding unnecessary over-regulation; and

-strengthening the Organization's technical co-operation programmes and delivery to achieve sustainable development and effective implementation of the Integrated Technical Co-operation Programme;

.3 to promote the intensification by Governments and industry of efforts to prevent and suppress unlawful acts which threaten the security of ships, the safety of those on board and the environment (in particular, terrorism at sea, piracy and armed robbery against ships, illicit drug trafficking, illegal migration by sea and stowaway cases); and

.4 to continue observing resolution A.500 (XII) and resolution A.777 (18), the continuing relevance of which has been reaffirmed on many occasions since their adoption.

It seems likely that IMO's priorities in the next Millennium will be to find ways of ensuring that new technology is introduced safely and that its impact upon people - and vice versa - is taken fully into account. The introduction of the ISM Code and the amendments made to the 1978 STCW Convention will both have far-reaching effects in the early years of the next century. But there are many other issues that will have to be considered as well.

The relationship between ship and shore

Traditionally, once a ship set sail the authority of the captain was absolute, mainly because, in the days before radio, there was no way in which he could be contacted. The invention of radio, satellite communications and radar have all helped to undermine that authority, since the shipowner is now only a telephone call away from the captain. As a result, in an emergency, shipmasters are often expected to contact head office before making a decision, such as whether to call for assistance.

The development of routeing measures over the last thirty years have also tended to reduce the authority of the master. Mandatory traffic separation schemes have been in force for twenty years and mandatory reporting in systems and vessel traffic services have also been introduced. These have all made a major contribution to safety, but at the same time have imposed further limits on the

traditional freedom of action of ships' masters. The Secretary-General summed up the position in a speech made at a seminar on VTS standards in May.

He said: "Improved navigational aids and communications mean that those on shore often have a better idea of conditions involving the ship than those on board the vessel itself. In the circumstances it is not surprising that masters have often developed doubts and uncertainties about their authority. If a ship is in trouble because of engine failure or some other technical fault the reaction is frequently for the captain to contact the owner for instructions rather than to make a decision on the spot that might cost the company a substantial amount of money and possibly cost the captain his job."

Mr O'Neil continued: "Despite all the qualifications and restrictions, the trend is unmistakable. It is towards more and more shore-based control. Comparisons are frequently made between shipping and aviation and although the two forms of transport are very different, the idea of aircraft operating without being subject to control from the ground is somewhat terrifying. When it is recognized that all forms of transportation except ships are controlled remote from the vehicle, it is hard to sustain any valid argument that vessels should continue to be exempted."

The need for greater control could become even greater as speeds increase. High-speed craft tend to operate on short-sea routes that are already crowded. Although there have been relatively few accidents involving such craft, there have been enough to cause concern. Today, the idea of allowing aircraft pilots to operate as they see fit, without any control from the land, is unthinkable. Will the same things apply to ships in twenty or thirty years' time?

The centre of gravity

When the IMO Convention was adopted in 1948 shipping was dominated by a handful of traditional maritime countries, mostly situated around the North Atlantic. In the half century that has followed, this balance has shifted, but the traditional maritime countries still have perhaps a dominant role. This is not likely to last for many decades. Countries in Asia have already established themselves as major economic and trading powers, many of them with huge populations. It is inevitable that their shipping sectors will develop in the same way.

As that trend develops, and extends to Latin America and Africa, the countries concerned will play an increasingly important role in IMO discussions. Over the years, IMO has proved itself capable of adapting to change very quickly and has always prided itself on keeping politics out of what are normally technical discussions. It is likely that further changes will be called for in the years to come. What is important is that the basic IMO principles, including the consensus approach to decision-making, are maintained.

Crime at sea

One of the most worrying developments of the last two or three decades has been the increase in criminal activities at sea. Piracy is now a major problem in many parts of the world and there has also been an increase in the number of stowaways, illegal immigrants and drug smuggling.

Piracy, one of the traditional scourges of the sea, seemed to have been eradicated a hundred years ago, but most of the other criminal activities that have appeared recently are new. They serve to make life even more difficult for the seafarers who have become accustomed to the normal perils of the sea but could now find themselves being threatened by criminals - and possibly being murdered.

IMO, at the request of Member States, has taken action to combat these threats, but there is a limit to what an international organization can do. Crime prevention is primarily a matter for individual and regional Governments and it is important that effective counter-measures are implemented as quickly as possible.

Implementation

Ever since 1981, when the IMO Assembly adopted resolution A.500 (XII), IMO has tried to concentrate on implementing existing regulations rather than the adoption of new ones. This has been a difficult task in an age of rapidly changing technology - if the regulations are not changed quickly enough IMO risks being accused of standing in the way of progress. Another complication has been the need to take action following a major disaster.

Nevertheless, it is generally agreed that the Organization's priority - or rather the shipping industry's priority - must continue to be the implementation of existing safety and environmental regulations. But implementation is the responsibility of the industry and of Governments and the evidence is that it has not always been given its proper importance. More than 25 years after the adoption of the MARPOL Convention, many ports still do not possess the waste reception facilities that they require. The fleets of some countries still have casualty rates that are a hundred times worse than others. The establishment of regional port State control systems has led to the detection and detention of numerous sub-standard ships. Yet such ships are still allowed to operate.

One of IMO's tasks in the new century will be to do more to encourage the implementation of standards.

A changing role for IMO?

One of the traditional complaints about IMO is that it has "no teeth." In fact it does: they are the Governments who form its membership and are responsible for ensuring that the standards they adopt in the IMO forum are put into effect. But the fact that implementation varies so widely and is so often ineffective has led some people to challenge the traditional approach and to ask if there should be a greater role for IMO.

The 1995 amendments to the International Convention on Standards of Training, Certification and Watchkeeping for Seafarers, 1978 (STCW) required Parties to submit to IMO details of their training, examination and certification procedures. This information is then examined by a panel of experts who then advise the MSC whether or not the requirements of the Convention have been met. This process is currently under way and no recommendations have so far been made.

But the fact that this authority has been delegated to IMO by Member States indicates that the Organization could be given a greater role in implementation in other areas. Could there, for example, be a role for IMO in establishing examination syllabi (the Organization already issues model courses for use in maritime academies)? Could there one day be a standard IMO examination? Will the time one day arrive when ships' officers are awarded IMO rather than national certificates of competency?

Has the time arrived for more openness in the shipping industry? Should Governments be required to carry out investigations into all serious casualties and to submit the findings to IMO? This would mean removing the long-standing opt out clause in Chapter I, regulation 21 which states the Government only has to do this "when it judges that such an investigation may assist in determining what changes in the present Regulations might be desirable."

When it comes to determining what went wrong in accidents at sea, it seems likely that technology will be able to help. The idea of installing voyage data recorders (VDRs) on ships has been around for a long time, but they are not mandatory, partly because of technical difficulties (for one thing, a ship may take weeks to reach its destination - and aircraft only a few hours). But in 1997 the IMO Assembly adopted a recommendation on performance standards for VDRs and Chapter V of the SOLAS Convention is also likely to be amended to make the use of VDRs mandatory on certain ships.

It seems certain that their use will be extended to other ships in due course and the technology of the recorders will increase enormously in the years to come. One result will be the provision of even more information about ships and casualties.

Coastal states

No matter what changes occur in shipping in the future, many countries will continue to have small merchant fleets compared with others. Yet many of these countries are and will be coastal States. As such they are often in a difficult position. They are expected to provide search and rescue facilities because of their geographical position, yet very few of the ships that benefit will be theirs. They own very few tankers - yet are continually threatened by operational and accidental pollution. They are expected to provide navigational aids and other systems - primarily for the benefit of others.

It is likely that there will be increasing demands for more to be done in this area by the shipping industry - which not only provides the ships but enjoys the profits made by them. The "marine electronic highway" in South East Asia is an example of co-operation that may become more common in the future. The Malacca Straits is one of the world's busiest shipping routes. Navigational infrastructure is being upgraded through a co-operative programme involving IMO, the coastal States and Japanese shipping interests, who are major users of the route.

Technical co-operation

Ever since the late 1960s IMO has operated a technical co-operation programme. Many of today's shipping nations did not even exist when IMO came into being in 1959 and it is likely that more countries will wish to expand their shipping activities as the new Millennium progresses. Yet they could be handicapped by lack of experience and resources. IMO has recognized this and done a great deal to overcome the problem. The World Maritime University, the IMO International Maritime Law Institute and the IMO International Maritime Academy were all set up in the 1980s to help developing countries to acquire the knowledge and skills necessary.

The traditional maritime countries among IMO's Membership gave generous support to this process, realizing that it is in everybody's interest to encourage high shipping standards.

Technology

When looking ahead it seems inevitable that one of the dominant forces in the future will be technology. It will transform the world of the future even more quickly - and more extensively - than it has changed the past. When it comes to the details, this paper has been and will continue to be deliberately vague. But one forecast does seem to be justified and that is that the continuation of the technological revolution in shipping will be of enormous benefit to the industry and those who work in it as well as to the marine environment itself. Providing, of course, that the shipping industry uses it wisely.

A change of culture

Perhaps the greatest challenge for IMO and the shipping industry will be to make safety such a priority that it becomes part of shipping culture. Other modes of transport have proved that this can be done: in some countries car drivers automatically put on their safety belts before they set off and motor cyclists always wear crash helmets. Passengers accept safety checks in airports because they are seen to be essential. In the past, the inherent dangers of the sea have resulted in seafaring itself being regarded as a dangerous occupation, where accidents are inevitable and have to be tolerated. There will be no excuse for allowing such attitudes to linger on into the next Millennium.

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