



Stranding of the Mega-Ship *Ever Given* in the Suez Canal: Causes, Consequences, and Lessons to Be Learned

Aleksander Gerson

Abstract In March 2021, the mega container ship *Ever Given*, a 400-m-long vessel weighing 200,000 tons, with a maximum capacity of 20,000 containers, grounded in the southernmost stretch of the Suez Canal. Ship convoys in the southern part of the Suez Canal can only travel in a single lane, therefore the grounding of the *Ever Given* effectively blocked all traffic through the Canal. The six-day blockage exacted a heavy financial price and loss of revenues for Egypt and for consumers worldwide. When the *Ever Given* was finally freed, she was arrested by Egyptian authorities and detained for over three months, while all her cargo worth hundreds of millions of dollars could not reach its various destinations, causing further financial losses and claims. This incident demonstrates the vital importance that Suez Canal holds for global maritime trade by considerably shortening the route between the Far East and Europe and the Americas (as an alternative to journeying around Africa). However, it highlights the consequences of failure to adapt to the pace of growth

A. Gerson (✉)

Wydra Division for Shipping and Ports Research,
Maritime Policy & Strategy Research Center, University of Haifa, Haifa, Israel
e-mail: alexgerson49@gmail.com

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of container ships in the last two decades, and the lack of preparedness of the Suez Authorities to deal with an event of such magnitude. The race to increase profitability by economies of scale has a profound global impact on shipping and ports. The article discusses the regulatory regime of this vital waterway in the context of responsibilities, liability, and cooperation between Suez Canal authorities and ships' commands. The lack of clarity regarding legal relationships between national authorities, ship operators, and masters is discussed with emphasis on straits, narrow passages, rivers, and channels.

Keywords Suez Canal blockage · Ever Given · Suez Canal widening and deepening · Global bottleneck passages · Suez Canal Authority · International Maritime Organization

On March 23, 2021, the mega container ship *Ever Given* grounded in the southernmost stretch of the Suez Canal. The *Ever Given* is a 400-m-long vessel weighing 200,000 tons, with a maximum capacity of 20,000 containers; owned by the Japanese Shoeni Kisen Kaisha and operated by Evergreen Line. Ship convoys in the southern part of the Suez Canal can only travel in a single lane, therefore the grounding of the *Ever Given* effectively blocked all traffic through the Suez Canal (Fig. 1).

Dislodging the giant ship required six days, causing a backlog of hundreds of ships unable to traverse the Suez Canal on their route to and from the United States, Europe, and the Far East.

The importance of the Suez Canal as a vital waterway for global maritime commerce, connecting the East and West of the globe, cannot be overestimated. The Canal annually serves some 19,000 ships carrying over 1 billion tons of cargo. Approximately 12–15% of global trade, around one million barrels of oil, and roughly 8% of transported liquefied natural gas pass through the Canal daily. An accident of such magnitude has a global impact on the vital maritime supply chain, with potential delays, backlogs, and financial losses to shippers, receivers, and the maritime community, lasting for many months after the ship has been freed and the Canal has resumed its activity (Fig. 2).

In this context, several questions arise:

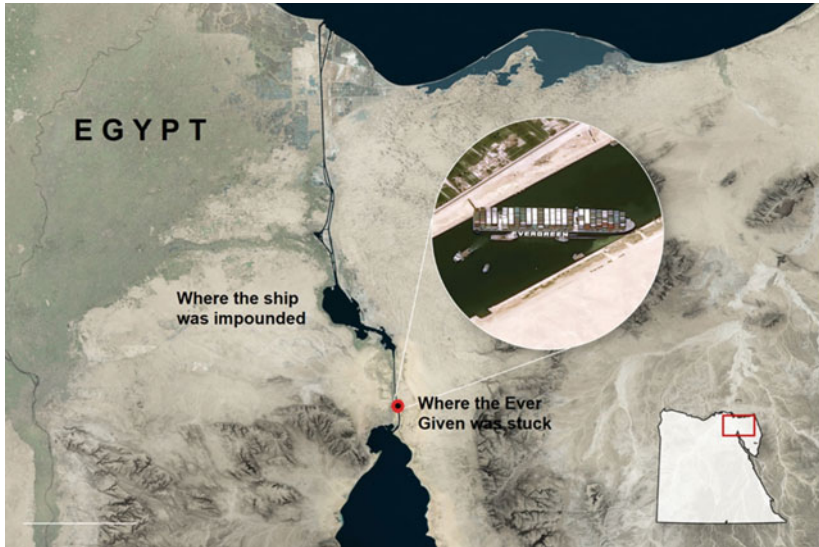


Fig. 1 Location of the grounding of the *Ever Given*¹



- Is the Suez Canal fit for purpose in the modern era of ever-growing container ships?
- Can the global maritime regulator—the IMO (International Maritime Organization)—adapt to the rapidly changing reality?
- Does the complex relationship between the captain and pilot (“The pilot has the conn,³ the master is in command”) require a fresh international approach and standardization?
- Have all lessons been learned from the accident?

HISTORIC PERSPECTIVE

The Suez Canal was opened in 1869, however its international status remained undefined for many years. In 1888, the major maritime powers of the time (with the exception of Great Britain) signed the Convention of Constantinople, which declared that the Canal should be open to ships of all nations in times of both peace and war (Fig. 3).

When it first opened, the Suez Canal consisted of a channel barely 8 m deep, 22 m wide at the bottom, and 61–91 m wide at the surface.

Alternative route for shipping while Suez Canal blocked

 Using Suez Canal	 Around Cape of Good Hope
10,000 nautical miles (18,520km)	13,500 nautical miles (25,002km)
25.5 days*	34 days*

*Based on ship's average speed of 16.43 knots

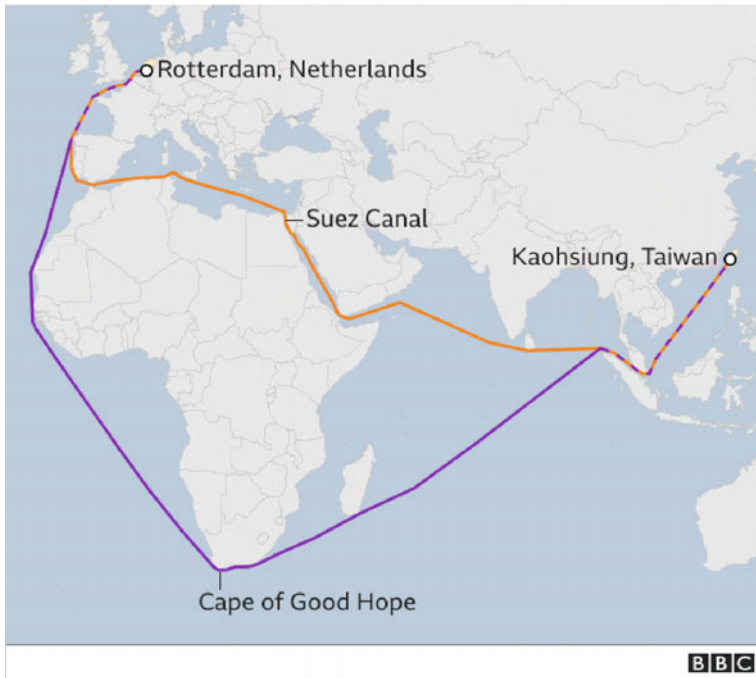


Fig. 2 Alternative shipping routes² (Source Vessels Value)

In order to allow ships to pass alongside each other, passing bays were constructed every 8–10 km (5–6 miles). However, in the first fifteen years some 3000 ships grounded because of the narrowness and tortuousness of the channel. Major improvements began in 1876, and, after successive widenings and deepenings, by the 1960s (almost one hundred years



Fig. 3 The Suez Canal, mid-twentieth century⁴

after its opening), the Canal had a minimum width of 55 m at a depth of 10 m along its banks and a channel depth of 12 m at low tide. During that period, passing bays were also greatly enlarged, and new bays were constructed. Bypasses were created in the Bitter Lakes and at Al-Ballah, stone or cement cladding and steel piling for bank protection were almost entirely completed in areas particularly liable to erosion, tanker anchorages were deepened in Lake Timsah (named after a Nile crocodile), and new berths were dug at Port Said to facilitate the grouping of ships in convoy.

The original Suez Canal did not permit two-way traffic, and ships were required to stop in a passing bay to allow the passage of reciprocal traffic. Transit time, which in the 1870s averaged 40 h, had been reduced to 13 h by 1939. A system of convoys was adopted in 1947, consisting of one northbound and two southbound per day, followed by further widening of the Canal. With the significant increase in tanker traffic, transit time since 1975 has ranged from 11 to 16 h. Upon entering the Canal at Port Said or Suez, ships are assessed for tonnage and cargo and are handled by one or two pilots for actual canal transit, which is increasingly

Fig. 4 Map of Suez Canal after August 2015



radar controlled. Southbound convoys moor at bypasses in Port Said, Al-Ballāh, Lake Timsah, and Al-Kabrīt, which allows northbound convoys to proceed without stopping. In August 2015, a new 35-km (22-mile) expansion running parallel to the main channel was opened, enabling two-way transit through most of the Canal. The main channel was deepened to allow for the passage of larger ships. The expansion project, launched by Egyptian President Abdel Fattah El-Sisi in 2014, was part of an effort to boost Egypt's economy.

Over the last century, the nature of Suez Canal traffic has altered significantly, in particular due to the enormous growth in shipments of crude oil and petroleum products from the Persian Gulf since 1950. Oil in northbound traffic multiplied 570 times (from 295,700 metric tons in 1913 to 168,700,000 metric tons in 1966). The closure of the Suez Canal between 1967 and 1975 (the Israeli-Egyptian conflict) triggered the introduction of large oil tankers on the route around the Cape of Good Hope (Fig. 2) and prompted the development and opening of the Sumed pipeline from Suez to Alexandria in 1977. At present, the Suez Canal handles 12–15% of global maritime traffic (Fig. 5).

A shift of Australasian trade from Europe to Japan and East Asia resulted in some decline in Suez Canal traffic, however the movement of oil from refineries in Russia, southern Europe, and Algeria has continued, chiefly to India, and the shipment of dry cargoes, including grain, ores, and metals has increased. A more recent feature has been the growth of container and roll-on/roll-off (“ro-ro”) traffic through the Canal, chiefly destined for the highly congested ports of the Red Sea and Persian Gulf.

Several global bottleneck passages possess some similarities to the Suez Canal: the Panama Canal, the Strait of Istanbul (the Bosphorus) connecting the Sea of Marmara and the Black Sea (which operates under the “Montreux” Convention of 1936), and the “Kattegat-Skagerrak” Passage connecting the Baltic and the North Seas. None, however, carries as great a share of world maritime tonnage in as narrow a channel as the Suez Canal, and none are located entirely within the full jurisdiction of a single country.

NARRATIVE OF EVENTS

The *Ever Given* is one of the largest container ships ever built (the latest builds reach 24,000 containers and belong to the Evergreen Company). Its keel floated only a few yards from the Canal's bottom. There were warning signs well before it ran aground. Just before dawn on March 23,

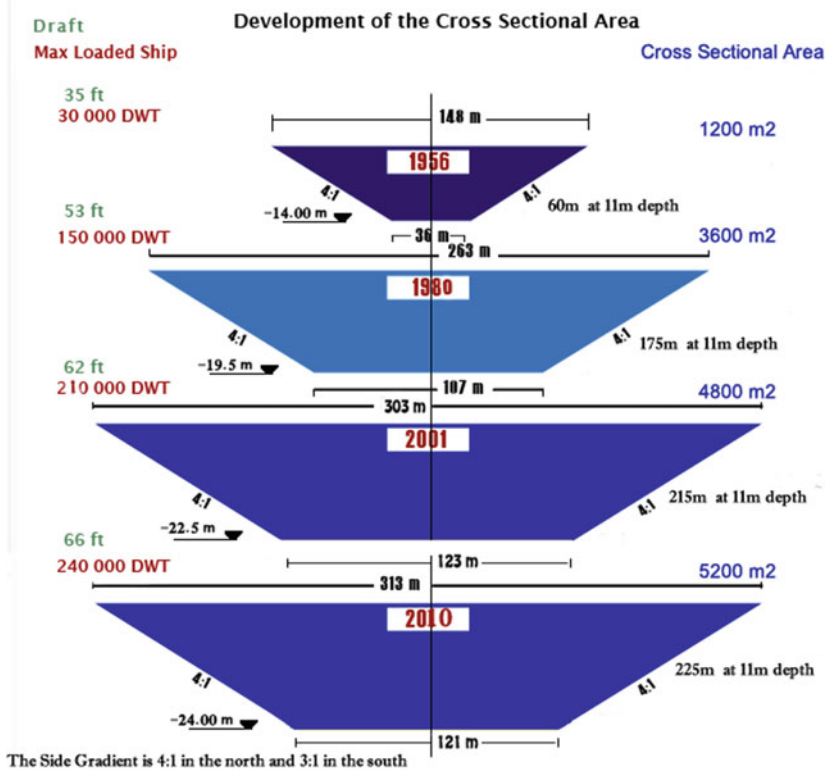


Fig. 5 Width and cross-sectional area of Suez Canal expanded with time⁵

2021, weather in the Suez Canal zone was worsening and the winds from the south had picked up, triggering a burst of concerned radio chatter among ships waiting to cross. The Canal Authority had no system in place for monitoring weather conditions or for warning ships regarding bad weather. The *Ever Given* and other ships were dragging their anchors, an unmistakable indication that the weather was unusually rough. Nevertheless, the ship’s captain decided to go ahead, perhaps submitting to the same high-pressure commercial demands that have driven the industry to build increasingly gigantic container ships over the past 15 years.

The global shipping market was already under strain in 2020–2021 because of the global COVID-19 pandemic and increased ordering of

online commodities by Western consumers under pandemic-related “lock-down.” Waiting for weather to improve would have delayed the cargo the *Ever Given* was carrying from Asia to Rotterdam, bound for customers in Europe. As the *Ever Given* entered the Suez Canal in a convoy of north-bound vessels, the wind from the south suddenly gusted to more than 49 knots (Nautical Miles per hour). Sheets of sand swirled across the Canal, graying the horizon and cutting visibility. Ships in the convoy soon lost sight of one another. When the visibility cleared a little before 8:00 a.m., the *Ever Given* was already wedged diagonally across the Canal (Fig. 6).

Pilots with local knowledge have been employed on board ships for centuries to guide vessels into or out of port safely or wherever navigation may be considered hazardous, particularly when a shipmaster is unfamiliar with the area.⁷ Using a pilot is compulsory in most ports. Under Suez Canal Authority rules, local pilots advise the ship’s crew on steering and navigation, although captains retain final responsibility and can overrule

MV *Ever Given* and the Suez Canal

The huge container ship of the Evergreen Marine Corporation has blocked the canal

THE MV *EVER GIVEN*

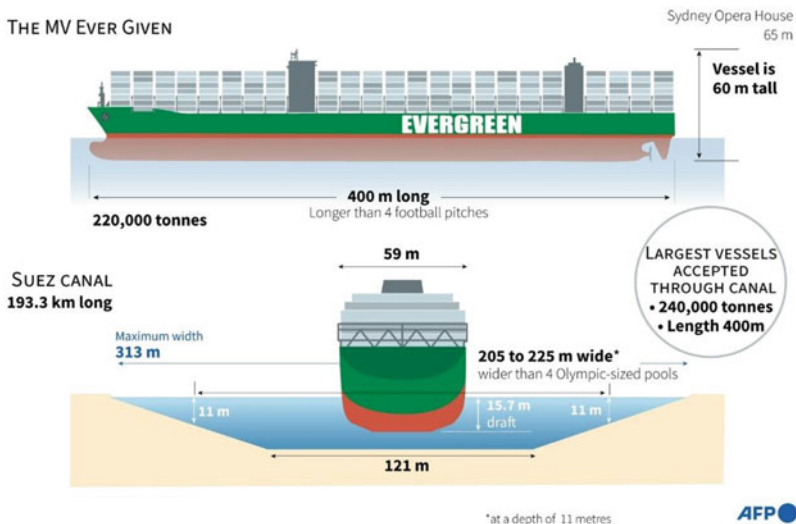


Fig. 6 Illustration showing the Suez Canal’s cross section vs. *Ever Given*⁶ (Source [fleetmon.com](https://www.fleetmon.com), Suez Canal authorities, Vessel finder)

a pilot's order. In practice, however, captains usually defer to the local pilots' expertise and rarely contradict their commands. At this point, it would be important to note that many (if not most) countries follow the antiquated British law (the UK Merchant Shipping Act of 1894), which largely exonerates the pilot from any responsibility in case of an accident ("Despite the duties and obligations of a pilot, his presence on board does not relieve the master or officer in charge of the watch from their duties and obligations for the safety of the ship"⁸). The Panama Canal is one of the few places where the canal pilot legally takes the responsibility for the navigation aspect of the passage of any vessel transiting the Panama Canal.

For example, despite various court rulings on the matter, one can still find the following in Israeli Maritime Law:

Damage by Vessels Under Pilotage Ordinance (No. 11 of 1939).

1. This ordinance may be cited as the Damage by Vessels Under Pilotage Ordinance, 1939
2. Notwithstanding anything contained in any Ottoman law or any other law or Ordinance the *owner or master of any vessel under pilotage, whether compulsory or otherwise, shall be answerable* for any loss or damage caused by the vessel or by any fault of the navigation of the vessel [emphasis added].

The captain may find himself in a difficult spot, being basically "damned if he does and damned if he doesn't." Although the International Convention of Safety of Life at Sea (SOLAS Chapter V regulation 34-1) states: "The owner, the charterer, the company operating the ship, or any other person SHALL NOT prevent or restrict the master of the ship from taking or executing any decision which, in the master's professional judgement, is necessary for the safety of life at sea and protection of the marine environment," the pilot is the local expert, is intimately familiar with all local conditions and procedures, and the master depends on him and will not readily overrule the pilot.

In the case of the *Ever Given*, the dynamic difficulties were put to the test almost as soon as the ship entered the Canal. A few miles in, the ship began weaving, perhaps shoved by the wind as its 14-story-high cargo was forming a huge windage area and functioned like a massive sail. Whatever

caused the initial zigzag, the Suez pilots' efforts to correct course proved counterproductive (Fig. 7).

Much of the sequence of events on the bridge was first reported by *Bloomberg Businessweek*.¹⁰ According to audio recordings from the ship's voyage data recorder (as reported by people who had access to the recording but spoke on condition of anonymity) one of the two pilots (on a ship of this size, there are usually two pilots during the transit) gave a series of unusually confused commands, shouting to the ship's helmsman to steer hard right, then hard left. When the pilot sent the ship as far as it would go in one direction, the captain apparently stepped in and straightened it, provoking an argument with the pilot. As the helmsman struggled to center the ship, there seemed to be a disagreement between the two pilots in regard to action to be taken. As it lurched up the canal, satellite data shows the *Ever Given* was already gaining speed. The first pilot ordered the ship to go "full ahead," revving it up to about 13 knots—much faster than the Canal's limit of about 8 knots. When the captain tried to intervene to slow the ship down, the pilot apparently responded with an implied threat to walk out (which was in any case an idle threat, as at that stage it would have been impossible). It must be emphasized that at the time of writing this chapter, official recordings of the VDR (Voyage Data Recorder) have not yet been published. However, the frantic radio traffic between pilots and Suez Canal control must have been picked up by other ships in the convoy and seamen who served on board the *Ever Given* must have spread the word.

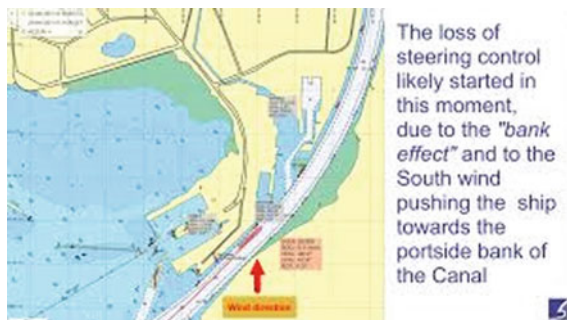


Fig. 7 *Ever Given* grounding in Suez Canal. AIS-based Dynamic Reconstruction from Maritime Casualty Specialists on Vimeo⁹

Citing experts, by speeding up, the pilot was likely trying to regain control of the rudder, which needs water rushing past it to work effectively. But the ship was now pushing a huge bow wave at high speed, generating an impossible-to-stop momentum of a 200,000 tons ship, thereby placing the *Ever Given* at the mercy of external forces.

Excessive speed while navigating a narrow channel, creates a range of problems that affect the ship's control. As the water around the ship rushed ever faster between the ship and the canal wall, its pressure was falling (similar to the Venturi effect). As a result, the *Ever Given* succumbed to what seafarers call the "bank effect" (or "cushion effect"), a phenomenon in which the stern tends to swing toward one bank while the bow is pushed away from it. Furthermore, the ship's "squat" (squat is a known physical property where the draught of a ship can become deeper (by meters) with an increase in speed and the proximity of shallow water and narrow channels¹¹) caused the ship's steering to become erratic, as the ship was sinking dangerously close to the canal bottom. Most likely, when under keel clearance (UKC) shrank dangerously (in maritime jargon—"smelling the ground") the ship might have become uncontrollable. This combination of factors probably sent the *Ever Given*'s bow plowing into the right bank of the canal. Twenty-two minutes after the pilots boarded the ship, the *Ever Given* was embedded so deeply in the sandy mud that it would take six days, a team of high-powered dredgers, and more than a dozen tugboats to dislodge it.¹² Fortunately, an unusually high tide contributed to the success of the operation.

Neither of the two tugboats accompanying the ship as per Suez Canal regulations was close enough and, in any case, they were insufficiently powerful to have prevented the ship's deviation. Figure 8 clearly shows the ship's bow and stern embedded in mud due to the sloping walls on both sides of the channel.

The Suez Canal Authority has, even at the time of writing, denied that its pilots were at fault, emphasizing that the "responsibility for pilotage operation in port and in Suez Canal lies entirely with the Master of the guided vessel even in case of the pilot's error" (Egyptian Maritime Code No. 8 of 1990 [Article 279]). The Suez Authority's senior chief pilot blamed the weather and the ship's sluggish response to steering, explaining: "What happened was beyond any pilot's control, with the sandstorm and the lack of visibility and strong wind." He added that the two pilots, whose names were not released, were both experienced

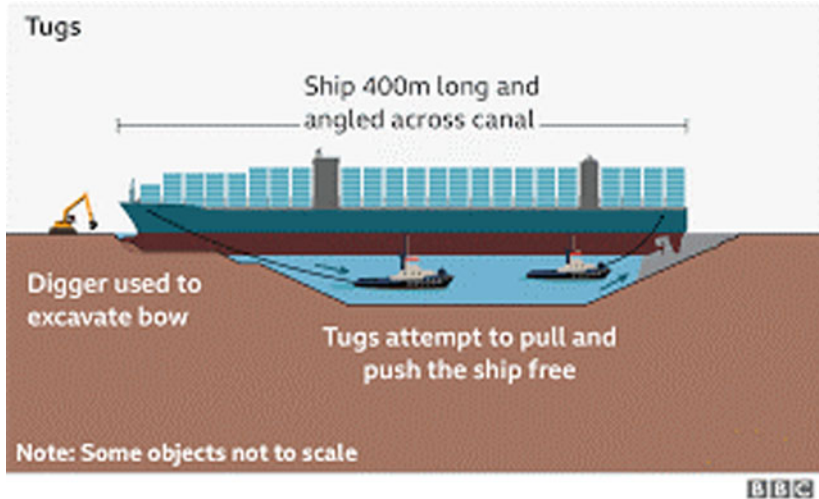


Fig. 8 Salvage attempts of the *Ever Given*¹³ (Source B5M, media reports)

senior pilots. A former head of the Suez Authority, when interviewed, acknowledged that even seasoned Suez pilots needed more training on the largest container ships, as currently they undergo only one training run on a real ship after practicing on a simulator. The ship's Japanese owner Shoei Kisen Kaisha declined to comment on the circumstances of the grounding. The ship's captain could not be reached for comment.

While dozens of other freighters roughly the size of the *Ever Given* had traversed the Suez uneventfully in the previous year, shipping analysts have been warning for years that container ships have grown too large to operate safely in many ports and canals. Fifteen years ago, the average container ship carried 4000–6000 containers and measured approximately 280–300 m long. The size of the new mega-ships had increased dramatically not just in length, but more importantly, in their beam and draught. However, the shipping industry was looking for larger, more efficient ships that could haul more while costing less. Ultra-large container vessels now stretch as long as 400 m, measure 65 m in width, have a draught of 16 m, and can carry more than 20,000 containers (the largest, *Ever Ace*, carries 24,000). Over a hundred such mega-ships now operate worldwide (Fig. 9).



Fig. 9 Cargo stacked 14 stories high on the “Ever Given”¹⁴

Professional voices in the industry have expressed concerns as to the handling of such ships, and have predicted the risks involved with the trend of smaller rudders on large ships, introduced in order to reduce fuel consumption, however associated with reduced maneuverability in channels and shallow water as compared to benefits gained in the open sea.¹⁵ Canals around the world have been widened to accommodate bigger ships. This includes the Suez Canal, which has been dredged and was expanded in 2015 to add a second lane. However, the 18-mile segment of the Canal where the *Ever Given* got stuck had not been widened, and the Canal’s tugboats were not sufficiently powerful to dislodge it once it was stuck. The Suez Canal Authority has so far declined to accept any responsibility for its part.

- Maritime protocols assign responsibility for investigating an accident to the country where the accident occurred and to the *country whose flag the ship flies*, in this case Panama, rather than to a neutral party such as the International Maritime Organization. It is customary for the investigating country to promptly share all information with the vessel’s Flag. On this occasion, Egyptian authorities were in no hurry to turn over important information to Panamanian investigators, including answers to queries regarding the pilots’ experience, bad-weather procedures, and conversations in the Suez Canal’s control tower.

- IMO regulations have not kept up adequately with the swiftly changing reality of technologies and the extremely rapid growth of container ships. Unlike the aircraft industry, there is no standardization in the ship's construction and/or bridge layout. The Convention of Safety of Life at Sea (SOLAS) "Chapter V – Safety of Navigation Regulation 2 (Shipborne navigation equipment and systems)" explicitly mentions only the basic compulsory equipment according to ships' size where the biggest ship is of 50,000 Gross Ton (GT) or above. The fact that the magnetic compass is still listed as the primary compass, demonstrates the maritime world's slow pace of adaptation to new technologies. The introduction of new international conventions or amendments to existing IMO conventions, codes, and resolutions, requires a clear majority among the 175 member states, rendering it a cumbersome and lengthy process. Ship owners are generally reluctant to invest in any technology that has not been made compulsory. Furthermore, the maritime industry is the most regulated industry of all (66 conventions and numerous international codes and resolutions), which makes efficient oversight difficult to carry out and creates a huge administrative burden on the captain and officers. A VDR is compulsory and should store information, in a secure and retrievable form, regarding the position, movement, physical status, command, and control of a vessel over the period leading up to and following an incident.¹⁶ However, a standard VDR may be substituted on cargo ships by a simplified system (S-VDR). Moreover, a ship's VDR does not provide the same level of information as that of the aviation industry black box, therefore may not provide sufficient information when investigating an accident.¹⁷
- Experts have advised that the IMO should mandate stricter standards. Regional rules and regulations employed in some places (such as the United States, EU, Singapore [Malacca Strait]) a sophisticated Vessel Traffic Systems (VTS), can similarly enhance the safety of navigation in port approaches or during long pilotage in rivers and channels. Such systems would greatly contribute to the safety of navigation in the Suez Canal.

THE AFTERMATH

A week after the accident and with a backlog of some 400 ships carrying cargo worth many billions of dollars waiting north and south of the Suez Canal, the *Ever Given* was dislodged and sailed to the Bitter Lakes near Ismailia where she was arrested by local court order for official investigation. Three months later, after payment of an undisclosed sum (apparently in excess of half a billion USD) by the owners, the ship was released.

During and after the Suez Canal blockage, the global maritime industry was engaged in debating its consequences, including means of overcoming the backlog of container ships waiting to discharge their cargo at ports of destination. Although the question of alternatives to the Suez Canal (round the Cape of Good Hope) has become relevant again, this will be very much dependent on fuel prices and daily hire of ships, both of which are currently very high. Ever since its deployment in the 1950s, container shipping has revolutionized global trade by expanding the availability of consumer goods and lowering prices. Exponential increases in the number of containers that may be stacked atop a single ship have effectively shrunk the globe further. Capacity has increased 15 fold over the last half-century and has nearly doubled over the last decade alone. However, these same advances have added vulnerabilities. A single major incident such as the disruption at the Suez Canal intensified the strains on the shipping industry and ports, which were already under pressure due to the COVID-19 pandemic.

The looming possibility of opening the Northern Passage and considerably shortening the route to the Far East (Shanghai to Rotterdam—16,000 Nautical Miles (NM) instead of 20,000 NM)¹⁸ is currently under advanced planning, including appropriate regulation by the IMO.¹⁹ However, many legal questions remain regarding international access to this waterway. Is it a passage or a strait? Currently, impediments facing all countries considering using the Northwest Passage include: the need for advanced ships and technology, high insurance costs, and the fees involved in using icebreaker escort vessels (Fig. 10).

The Suez Canal Authority has moved briskly to prevent future disruptions of canal traffic, which generates more than \$5 billion a year (\$6.7 billion in 2021) in much-needed foreign currency for Egypt.

In early 2022, the state-owned Suez Canal Authority (SCA) announced plans to extend the two-way section south of the Great Bitter Lake by lengthening the second Canal Lane (opened in 2015) by 10 km,

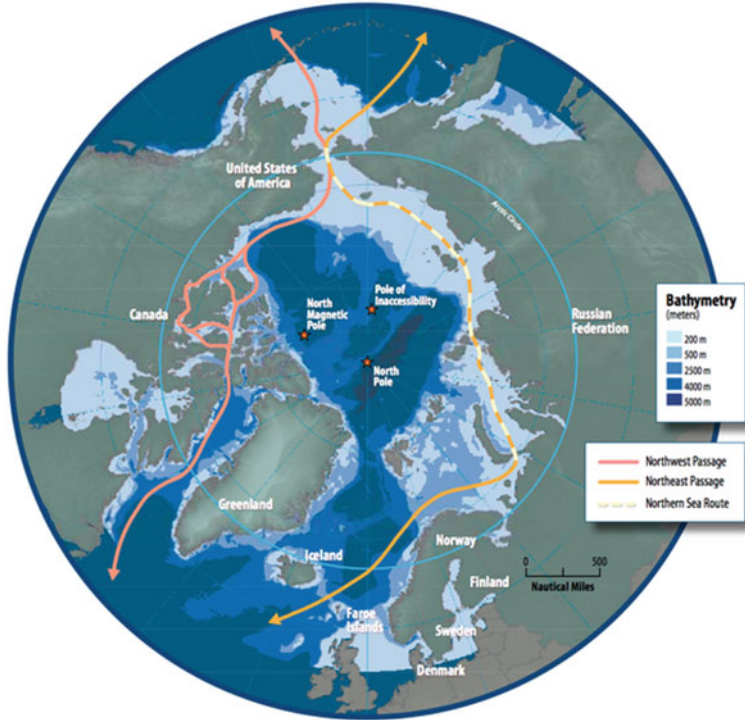


Fig. 10 Potential route via Northwest Passage²⁰

totaling 82 km in length. In addition, it plans to widen and deepen a single lane stretch at the southern end of the Canal. These projects are expected to be completed by July 2023 after two years of work, as announced by the chairman of the Suez Canal Authority (SCA).²¹ Plans were also announced to purchase a fleet of more powerful tugboats, a support vessel, and cranes that could partially relieve the load of any future grounded ship.

Egyptian experts emphasize that no alternative trade route can compete with the unique advantages of the Suez Canal's geographic location, including fewer accidents than on other global trade routes; lower costs than land trade routes requiring loading and unloading of goods; future options for widening and deepening the Suez Canal route, if necessary; and advanced control systems.²²

DISCUSSION

With the perspective of a ship's captain of many years' experience, having traversed the Suez Canal numerous times, as well as serving as former Deputy Director of the Israeli Maritime Administration and a representative to the IMO, several issues come to mind that should be considered by the maritime industry:

- Ports and approaches for docking mega-ships require sufficient depth and robustly constructed piers that can support cranes with a reach exceeding 60 m. Most existing ports worldwide, for example in northern Europe and the eastern United States, are not suitable for handling mega container ships. Only 20 ports in the world can accommodate 19,000 TEU (Twenty-foot Equivalent Unit, i.e., a 20-foot-long container) vessels.²³ Major European ports such as Rotterdam, Antwerp, Felixstowe, and Liverpool are investing huge sums in adapting their ports to the logistics of handling mega-ships, while the remainder of ports can only be served by smaller vessels. This might herald the end of the traditional city-port era, with dedicated ports being constructed at a considerable distance from the city.
- The potential for ecologic disaster in case of an accident involving a mega-ship, is significantly increased, in view of the quantity of cargo on board, including very large amounts of dangerous goods and the large quantities of fuel required for propulsion of such ships.
- In the adverse weather circumstances of the Suez Canal on March 23, 2021, the *Ever Given's* captain might have considered delaying entry to the Suez Canal had he been confident of receiving support from his employer for exercising professional judgment. The massive shift of the maritime industry to Flags of Convenience (FCs) and international Management Companies, means that seafaring crews can be recruited from anywhere in the world (preferably as cheaply as possible). This often places the captain under undue pressure from owners, charterers, and management, but lacking the support of a national administration or organized workers' union. These situations may impinge on the masters' ability to exercise their authority and make difficult decisions.

- The ambiguous master–pilot relations, as demonstrated in the case above, beg to be re-addressed in general, with emphasis on navigation in narrow passages/channels and other places of vulnerability, where the captain has a very limited scope of control.
- A “Crew Negligence” clause is standard in all marine ship insurance contracts. This means that while the owner claims insurance in case of a mishap, based on this clause the captain and the officers are automatically labeled responsible. This circumstance frequently facilitates laying the blame on ship’s command, and it sometimes means the end of their career. A case example is the master of the *Erika*, which broke in two and sank in a storm in the Bay of Biscay (1999).²⁴ The Indian-nationality captain acted professionally and saved the entire crew prior to the ship’s sinking. While the owner received insurance compensation, the captain was summarily dismissed and was never re-employed as a captain.

The case of the stranding of the *Ever Given* has touched upon and highlighted several burning issues related to international shipping in the modern era.

Will the exponential growth of container ships continue, or will it be curbed in view of the diminishing returns beyond a certain size,²⁵ as well as the increase in risks of a vessel of such size involved in a serious accident?

Energy prices are soaring and a steep increase in Suez Canal transit fees has been introduced (approximately 15% in 2022—a 20,000 TEU container ship will pay approximately \$700,000 for a single transit²⁶). Approximately 60% of the cost savings of the most recent container ships are related to more efficient engines. Have the advantages of economies of scale exceeded their usefulness, and will the maritime community push more aggressively for alternative routes and invest in new propulsion techniques?²⁷ These trends will unravel in the future.

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