How did it happen?

How can we mitigate similar events in the future?

A virtual event hosted by

the ADAC, CCICADA and CREATE DHS Centers of Excellence

CAPT David B. Moskoff, USMS
Professor of Marine Transportation
United States Merchant Marine Academy
MARAD – U.S. Department of Transportation

The opinions expressed are his own and not necessarily those of any government entity
**50 YEARS OF CONTAINER SHIP GROWTH**

<table>
<thead>
<tr>
<th>Year</th>
<th>Ship Name</th>
<th>TEU Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1968</td>
<td>Encounter Bay</td>
<td>1,530</td>
</tr>
<tr>
<td>1972</td>
<td>Hamburg Express</td>
<td>2,950</td>
</tr>
<tr>
<td>1980</td>
<td>Neptune Garnet</td>
<td>4,100</td>
</tr>
<tr>
<td>1984</td>
<td>American New York</td>
<td>4,600</td>
</tr>
<tr>
<td>1996</td>
<td>Regina Maersk</td>
<td>6,400</td>
</tr>
<tr>
<td>1997</td>
<td>Susan Maersk</td>
<td>8,000+</td>
</tr>
<tr>
<td>2002</td>
<td>Charlotte Maersk</td>
<td>8,890</td>
</tr>
<tr>
<td>2003</td>
<td>Anna Maersk</td>
<td>9,000+</td>
</tr>
<tr>
<td>2005</td>
<td>Gjertrud Maersk</td>
<td>10,000+</td>
</tr>
<tr>
<td>2006</td>
<td>Emma Maersk</td>
<td>11,000+</td>
</tr>
<tr>
<td>2012</td>
<td>Marco Polo (CMA CGM)</td>
<td>16,000+</td>
</tr>
</tbody>
</table>

**Scales for Perspective**

Container-carrying capacity has increased by around 1,500% since 1968 and has almost doubled over the past decade.

Source: MaritimeCyprus.com
**General characteristics**

<table>
<thead>
<tr>
<th>Type</th>
<th>Container ship</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tonnage</td>
<td></td>
</tr>
<tr>
<td>• 220,940 GT</td>
<td></td>
</tr>
<tr>
<td>• 99,155 NT</td>
<td></td>
</tr>
<tr>
<td>• 199,629 DWT</td>
<td></td>
</tr>
<tr>
<td>Displacement</td>
<td>265,876 t (261,677 long tons)</td>
</tr>
<tr>
<td>Length</td>
<td>399.94 m (1,312 ft 2 in)</td>
</tr>
<tr>
<td>Beam</td>
<td>58.8 m (192 ft 11 in)</td>
</tr>
<tr>
<td>Draught</td>
<td></td>
</tr>
<tr>
<td>• 14.5 m (47 ft 7 in) (design)</td>
<td></td>
</tr>
<tr>
<td>• 16.0 m (52 ft 6 in) (maximum)</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>32.9 m (107 ft 11 in)</td>
</tr>
<tr>
<td>Installed power</td>
<td>Mitsui–MAN B&amp;W 11G95ME-C9 (59,300 kW)</td>
</tr>
<tr>
<td>Propulsion</td>
<td></td>
</tr>
<tr>
<td>• Single shaft; fixed pitch propeller</td>
<td></td>
</tr>
<tr>
<td>• Two <strong>bow thrusters</strong></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>22.8 knots (42.2 km/h; 26.2 mph)</td>
</tr>
<tr>
<td>Capacity</td>
<td>20,124 TEU</td>
</tr>
<tr>
<td>Crew</td>
<td>25</td>
</tr>
</tbody>
</table>

---

**History**

<table>
<thead>
<tr>
<th>Name</th>
<th><strong>EVER GIVEN</strong>[^a]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner</td>
<td>Shoei Kisen Kaisha[^1][^2]</td>
</tr>
<tr>
<td>Operator</td>
<td>Evergreen Marine</td>
</tr>
<tr>
<td>Port of registry</td>
<td>Panama City, Panama</td>
</tr>
<tr>
<td>Builder</td>
<td>Imabari Shipbuilding (Japan)</td>
</tr>
<tr>
<td>Yard number</td>
<td>S-1833</td>
</tr>
<tr>
<td>Laid down</td>
<td>25 December 2015[^3]</td>
</tr>
<tr>
<td>Launched</td>
<td>9 May 2018[^3]</td>
</tr>
<tr>
<td>Completed</td>
<td>25 September 2018[^3]</td>
</tr>
</tbody>
</table>

[^a]: Name
[^1]: Owner
[^2]: Operator
[^3]: Port of registry
[^4]: Builder
[^5]: Yard number
[^6]: Laid down
[^7]: Launched
[^8]: Completed
So how did this happen?
Complex Set of Factors

Ship and Equipment -

Ultra Large Ship
Very Large Sail Area
Rudder and Propeller
Ship Speed – about 13.5 knots
Normal Speed about 5-7 knots

Canal Hydrodynamics –

Bank and Cushion Effects
Squat Effects

Environmental -

Wind from SSW at 45+ knots
M/V EVER GIVEN Grounding in Suez Canal
CAPT David B. Moskoff
CCICADA Workshop 21 June 2021
Bank and Suction Effects
Squat effect in shallow water

Source: Naututor
Source: Suez Canal Authority (SCA)
MV Ever Given and the Suez Canal

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

**THE MV EVER GIVEN**

- **Length**: 400 m (longer than 4 football pitches)
- **Capacity**: 220,000 tonnes

**SUEZ CANAL**

- **Length**: 193.3 km
- **Maximum Width**: 313 m
- **Width**: 205 to 225 m (wider than 4 Olympic-sized pools)

**LARGEST VESSELS ACCEPTED THROUGH CANAL**

- **Capacity**: 240,000 tonnes
- **Length**: 400 m

**Sydney Opera House**

- **Height**: 65 m
- **Vessel is 60 m tall**

Sources: fleetmon.com, Suez Canal authorities, Vessel finder

*at a depth of 11 metres*
Mitigation

What can be done to lessen the probabilities of this reoccurring?

- Deeper/Wider Canal – Dredging (underway)
- Tugboat Escort – Faster/More Powerful Tugs
- Weather Monitoring - Control of Traffic - VTS
- Training – Live Models and Class A Simulation
- Management – Better Delineation of Pilots and Vessel Masters Onboard
- Audit Teams – Regular Monitoring of Vessels
Questions, Comments?

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Senior Advisor – DoD Purposeful Interference Response Team (PIRT)
Senior Expert - NATO Transport Interference Group Ocean Shipping (TG OS)
M/V EVER GIVEN
Grounding in Suez Canal

Slides for Q & A

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CAPT David B. Moskoff

CCICADA Workshop 21 June 2021
Authorities attempt to lighten wedged container ship

The Ever Given’s massive weight, some 220,000 tons, is making it very difficult to dislodge and float. Instead, the team says it may have to lighten the ship and then try to nudge the ship using tugboats.

1. More dredging is required before any attempt to dislodge the vessel.
2. To lighten the load, authorities will have to move a crane beside the Ever Given to unload the cargo containers.
3. The ship will have to be drained of the water serving as ballast.
4. A lighter ship can then be pulled back by tugboats.

Source: Google Earth; AP reporting
Was Ever Given Never Given A Chance In The Suez Canal?

Meteomatics’ AG has calculated Ever Given’s wind drag at the time of the collision which infers that the grounding was inevitable, considering the strong wind gusts, Ever Given’s surface area and available engine power.

The International Maritime Organisation (IMO) has already launched an investigation into what could have caused the grounding of the Ever Given.
Did the high winds make grounding inevitable?

The theory of the ship encountering difficulty with the strong winds is supported by information on the ship’s last known speed before the grounding was 13.5 knots, higher than the canal’s 7.6 knots. High speeds can be used to mitigate the impacts of strong high wind speed, according to experienced captains, as reported by Bloomberg.
Tugs attempt to pull and push the ship free

Digger used to excavate bow

Ship 400m long and angled across canal

Note: Some objects not to scale

Source: BSM, media reports