ACCIDENT REPORT

Report on the investigation of heavy contact

with the quay and two shore cranes

by the UK registered container ship

CMA CGM Centaurus

at Jebel Ali, United Arab Emirates

4 May 2017

MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

SERIOUS MARINE CASUALTY REPORT NO 17/2018 OCTOBER 2018

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2012 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 14(14) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2012, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purposes is to attribute or apportion liability or blame.

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AIS	-	Automatic Identification System
BPG	-	(ICS) Bridge Procedures Guide
BRM	-	Bridge Resource Management
BRM-P	-	Bridge Resource Management training for pilots
CHA	-	Competent Harbour Authority
CoC	-	Certificate of Competency
con	-	Conduct of the navigation of a ship
DfT	-	Department for Transport
DGPS	-	Differential Global Positioning System
ECDIS	-	Electronic Chart Display and Information System
GPS	-	Global Positioning System
ICS	-	International Chamber of Shipping
IMO	-	International Maritime Organization
IMPA	-	International Maritime Pilots' Association
ISM	-	International Safety Management (Code)
KPI	-	Key performance indicator
kts	-	knots
kW	-	kilowatt
LOA	-	length overall
m	-	metre
MADAS	-	(MAIB) Marine Accident Data Analysis Suite
MAIIF	-	Marine Accident Investigators' International Forum
MCA	-	Maritime and Coastguard Agency
MGN	-	Marine Guidance Note
MPX	-	Master/pilot information exchange
nm	-	nautical mile
OOW	-	Officer of the Watch
PMSC	-	Port Marine Safety Code

ROT	-	rate of turn
SMS	-	Safety Management System
SOLAS	-	International Convention for the Safety of Life at Sea 1974, as amended
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended
TEU	-	twenty foot equivalent unit
UAE	-	United Arab Emirates
UKC	-	Under Keel Clearance
UTC	-	Universal Co-ordinated Time
VHF	-	Very High Frequency
VLCS	-	Very Large Container Ship
VRM	-	Variable Range Marker
VTM	-	Vessel Traffic Management
VTS	-	Vessel Traffic Services

TIMES: all times used in this report are Local Time (UTC +4) unless otherwise stated.

Figure 1: *CMA CGM Centaurus*

SYNOPSIS

At 1137 on 4 May 2017, the UK registered container ship *CMA CGM Centaurus* made heavy contact with the quay and two shore cranes while executing a turn under pilotage during its arrival at Jebel Ali, United Arab Emirates. The accident resulted in the collapse of a shore crane and 10 injuries, including one serious injury, to shore personnel.

The MAIB investigation established that *CMA CGM Centaurus* was going too fast for the intended manoeuvre when the pilot started the turn. The pilot was aware that the ship might have been travelling a little faster than he would have liked when he initiated the turn, but was content that the ship would be able to complete it. The ship's bridge team were uncertain of the maximum speed required to complete the turn safely. There was no agreed plan for the intended manoeuvre, and therefore no shared mental model between the bridge team and the pilot. Consequently, the pilot was operating in isolation without the support of the bridge team, allowing the pilot's decision-making to become a single system point of failure.

The pilot's performance was focused on efficiency, which influenced his decision to turn the ship into the basin without ensuring that the manoeuvre was conducted at a sufficiently slow speed to enable its safe completion. The pilot's decision to turn at high speed was not effectively challenged because the ship's bridge team lacked the necessary knowledge and experience to be able to confidently intervene and correct the pilot's action.

The size of container ships has grown at a rapid pace, yet ports remain largely the same. Margins for error are therefore decreasing. It is imperative that pilots and ships' bridge teams work together and implement the best practices of Bridge Resource Management to ensure the safety of both ships and ports.

Action has been taken by CMA Ships to improve onboard pilotage management throughout its fleet. A recommendation has been made to DP World UAE Region aimed at improving its management of pilotage and berthing operations in respect of large container ship movements within the port of Jebel Ali.

A recommendation has been made to the International Chamber of Shipping, the International Maritime Pilots' Association and the International Harbour Masters' Association to promote the benefits of adhering to effective bridge resource management procedures during acts of pilotage and to endorse the Bridge Resource Management training for pilots course as an effective means of achieving this.

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *CMA CGM CENTAURUS* AND ACCIDENT

SHIP PARTICULARS	
Vessel's name	*CMA CGM Centaurus*
Flag	UK
Classification society	Bureau Veritas
IMO number	9410777
Type	Container ship
Registered owner	Alize 1996
Manager(s)	CMA Ships
Construction	Steel
Year of build	2010
Length overall	363.61m
Registered length	351.29m
Gross tonnage	131,332
Minimum safe manning	15
Authorised cargo	Containers
VOYAGE PARTICULARS	
Port of departure	Singapore
Port of arrival	Jebel Ali
Type of voyage	International
Cargo information	Containers
Manning	27
MARINE CASUALTY INFORMATION	
Date and time	4 May 2017, 1137
Type of marine casualty or incident	Serious Marine Casualty
Location of incident	Jebel Ali, United Arab Emirates (UAE)
Place on board	Bow, forecastle and starboard shoulder
Injuries/fatalities	10 injuries, including one serious injury, to shore personnel
Damage/environmental impact	Structural damage to the ship. Damage to the port infrastructure, including the collapse of a shore crane
Ship operation	Manoeuvring
Voyage segment	Arrival
External & internal environment	Daylight, good visibility. Wind: north-north-east, force 3. Air temperature: 39ºC. Negligible tidal stream
Persons on board	29

1.2 NARRATIVE

At 1024 on 4 May 2017, *CMA CGM Centaurus* **(Figure 1)** arrived at the pilot station off Jebel Ali, UAE, following a 10-day passage from Singapore. A pilot had been booked for 1030. Jebel Ali Port Control advised the ship's master by very high frequency (VHF) radio to continue towards the entrance of the buoyed channel **(Figure 2)**.

At 1031, a pilot and a trainee pilot boarded the ship at the channel entrance and were escorted to the bridge. *CMA CGM Centaurus* was proceeding at 'half ahead' and making good a speed of around 9 knots (kts). The master was on the bridge accompanied by the chief officer and a deck cadet, and the ship was being steered manually by a helmsman.

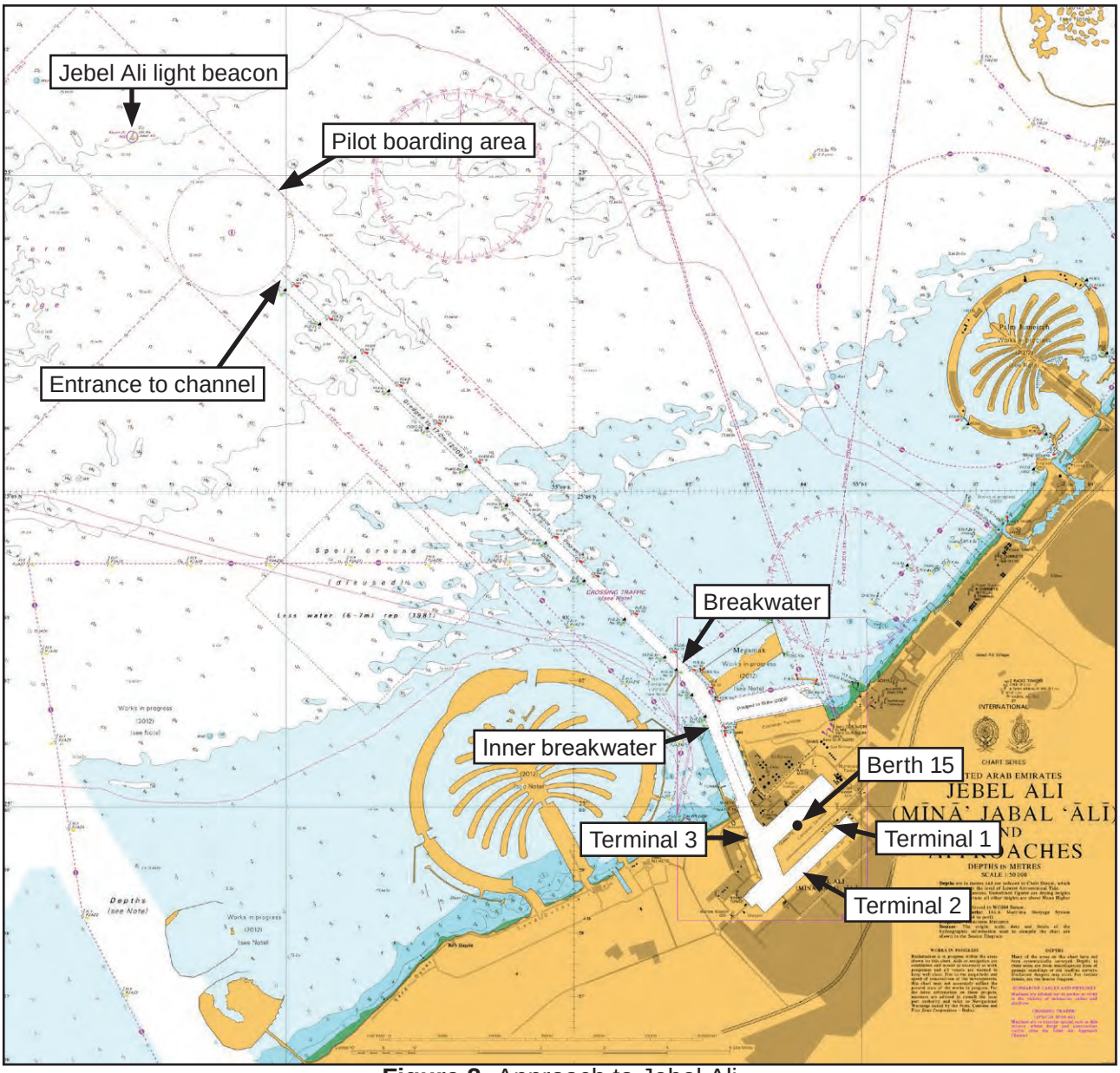

Figure 2: Approach to Jebel Ali

At 1036, the pilot and trainee pilot arrived on the bridge. The pilot ordered 'full ahead' and said "*Welcome to Dubai*". The master then advised the pilot that the ship had a draught of 15.52m and was 'very heavy'. The pilot told the master that the ship was destined for Terminal 1, Berth 15 **(Figure 3)**, and would be berthing port side alongside with the ship's backsprings to be sent ashore first. The pilot also told him that two tugs would be used for berthing, one on the ship's starboard bow and one on the starboard quarter. At 1043, the pilot asked the master if the ship was 'good turning', to which the master replied "*She is, but maybe she's heavy*".

A radar was allocated to the pilot for his own use on the port side of the main bridge console **(Figure 4)**. The chief officer used a radar on the starboard side of the main console to monitor the navigation. The master operated the telegraph and the helmsman steered the ship manually to the pilot's orders. The deck cadet kept the movement log and completed other jobs as assigned by the chief officer. The trainee pilot took no active role in the ship's navigation and was on board as an observer only.

At 1102, with *CMA CGM Centaurus* making good a speed of 13.4kts, the pilot ordered 'half ahead'. He then said to the trainee pilot "*Let me see how she turns. Then I'll decide if we go inside or back in. I want to see how she turns. If sluggish, we'll back in"*.

At 1107, with *CMA CGM Centaurus* making good a speed of 12.8kts, the pilot ordered 'slow ahead' and, a minute later, 'dead slow ahead'. He then communicated on VHF radio with the pilot on *Emirates Dana*, a container ship that was preparing to depart from Berth 19, and said "*I'll turn in and keep clear. I'll be out of your way*".

At 1109, the pilot ordered the helmsman to alter course from 134º to 159º, and then communicated on VHF radio with the tug skippers. He ordered one of them to make fast on the starboard shoulder, and the other to stand-by with the intention to make fast when the ship was inside the basin. The master confirmed to the pilot that the bow thruster was ready for use.

At 1117, with *CMA CGM Centaurus* making good a speed of 8.3kts, the pilot told the master that, although the chart indicated a depth of 14m, the Terminal 1 basin was dredged to a depth of 16.5m.

At 1122, with the ship making good a speed of 7kts, the pilot ordered 'slow ahead'. The second officer, who was stationed on the ship's forecastle, reported to the bridge team that the tug *Asad* was made fast forward. The pilot then communicated again on VHF radio with the pilot on *Emirates Dana*, saying "*Wait on me. We will be turning into the basin and swinging off the berth*". At 1124, *Emirates Dana*, assisted by two tugs, departed from Berth 19 **(Figure 3)**.

At 1125:46, the pilot on *CMA CGM Centaurus* ordered 'dead slow ahead' and set the variable range marker (VRM) on his allocated radar to a distance of two ship lengths.

At 1129:47, with the VRM touching the displayed echo of the corner of the quay, and with the ship making good a speed of 6.3kts, the pilot ordered 'port 20º', and then 'hard to port'.

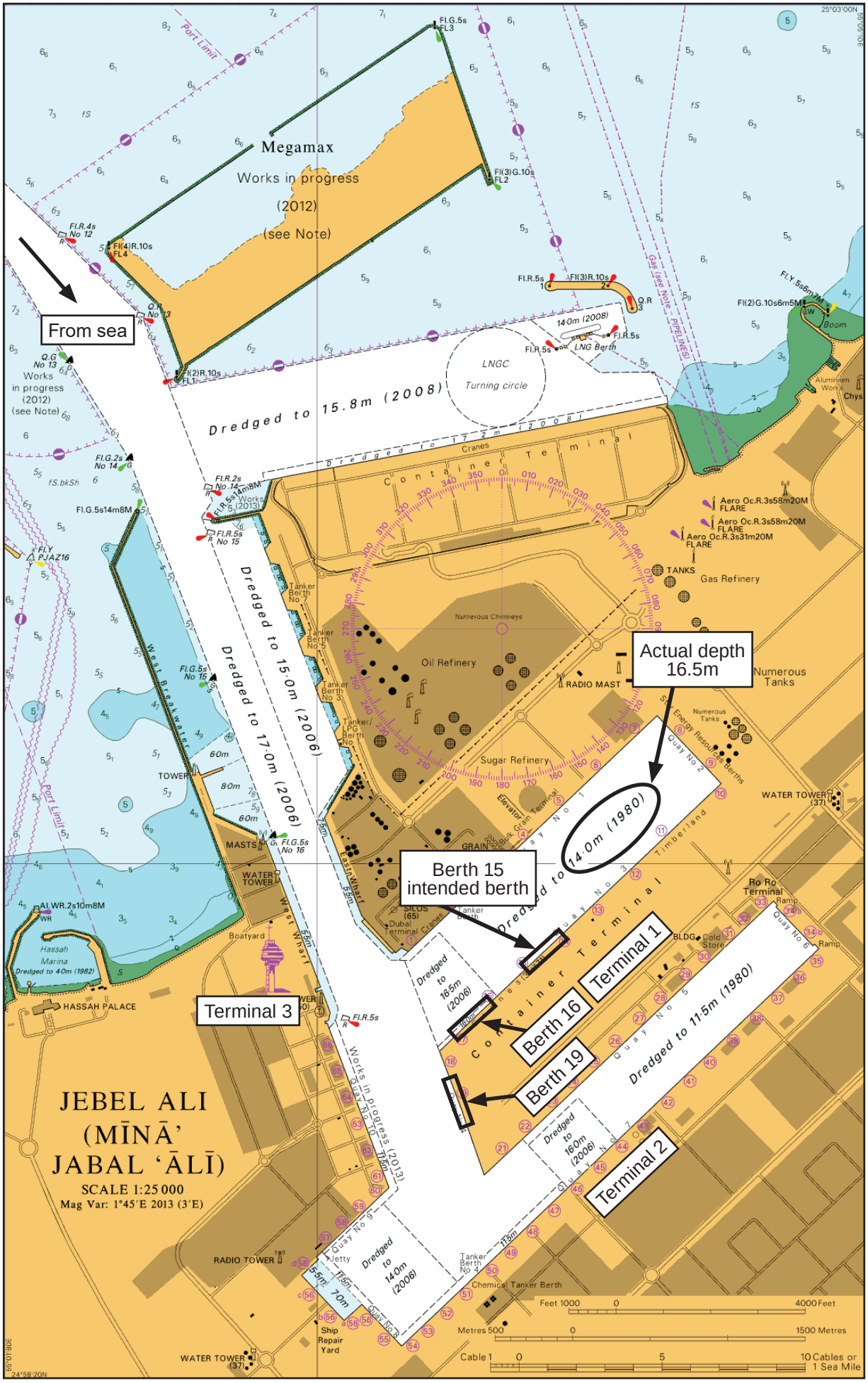

Figure 3: Jebel Ali

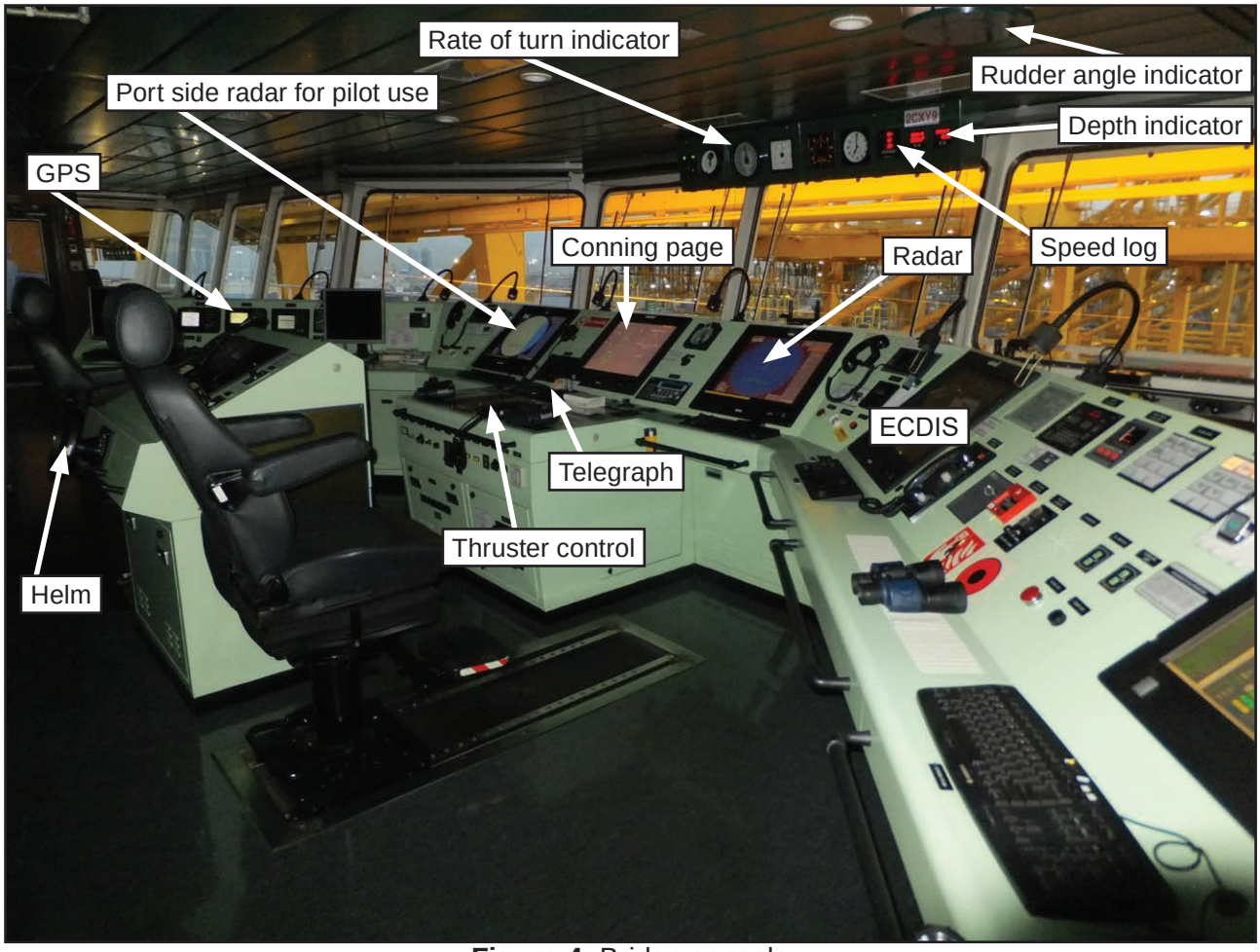

Figure 4: Bridge console

At 1130:29, the pilot ordered 'port 20º', and then stated aloud "*It is a problem if start turn too early*". The master replied "*I think it is too late"*. The pilot then ordered 'hard to port' and 'slow ahead'.

At 1132:18, the pilot ordered 'half ahead', and confirmed with the helmsman that the helm was 'hard to port' **(Figure 5a)**[1]. The pilot then ordered for the tug *Asad* to push with full power on the ship's starboard shoulder, and for the tug *Timrar* to push with full power on the ship's port quarter. He also ordered the master to use the bow thruster with full power to port and, 30 seconds later, ordered 'full ahead'. With the ship swinging to port at a rate of 12º per minute, the pilot told the master "*All will be good when they attain a rate of turn of 20-25º per minute*". The master replied "*She's very heavy"*.

As *CMA CGM Centaurus* was turning to port, it was also setting laterally to starboard towards the container ship *NYK Crane*, which was secured alongside and discharging containers at Berth 16.

At 1135:20, with the second officer on the ship's forecastle reporting decreasing closing distances from *NYK Crane*, the pilot ordered 'hard to starboard'. The master stated "*This is no good*". He then called the engine room by telephone, advising of the need to prepare for an emergency manoeuvre. Meanwhile, the pilot instructed the tug *Timrar*'s skipper by VHF radio to "*immediately come on other side*".

[1] Figure 5a-f shows composite reconstruction using the (MAIB) Marine Accident Data Analysis Suite (MADAS).

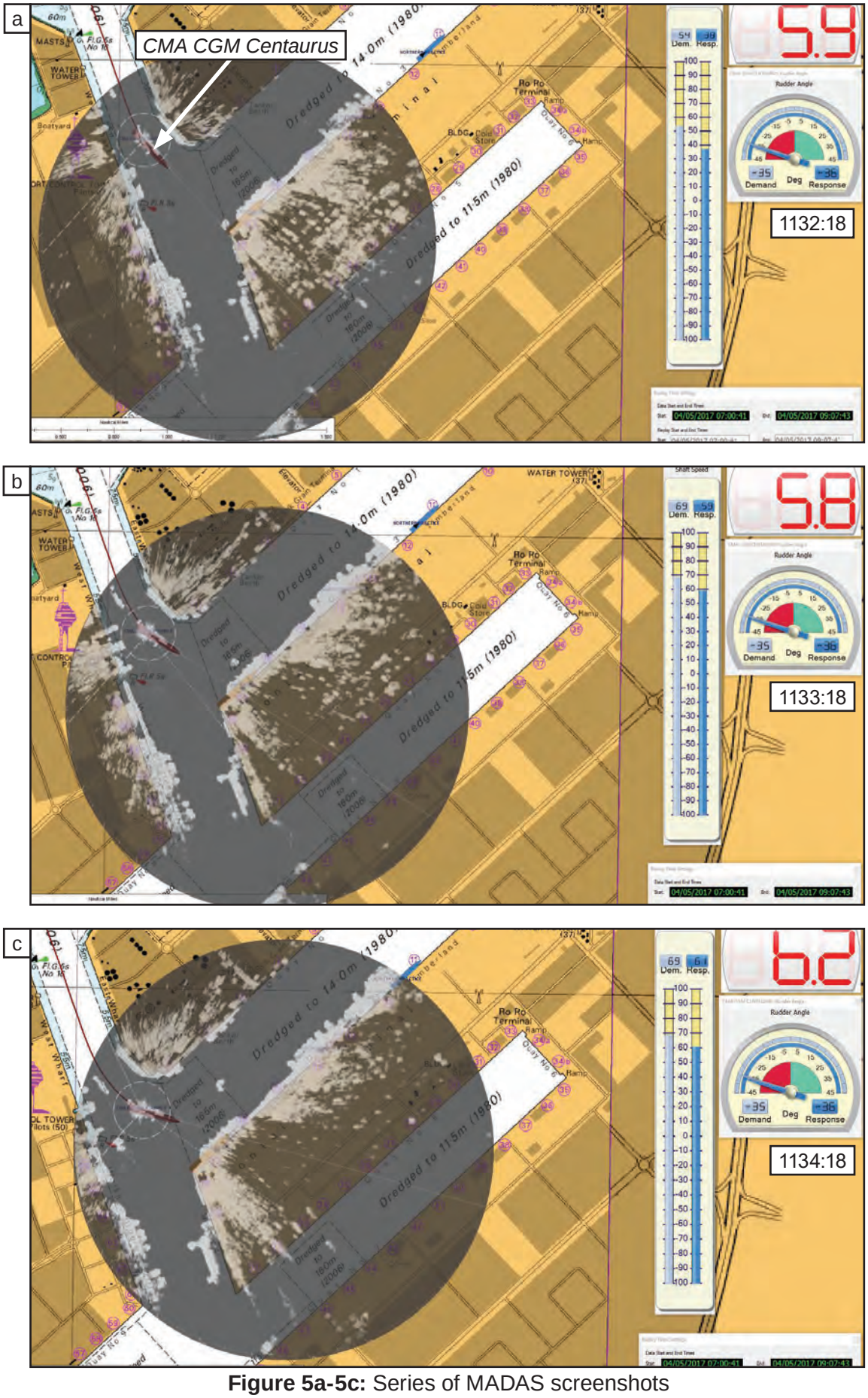

Figure 5a-5c: Series of MADAS screenshots

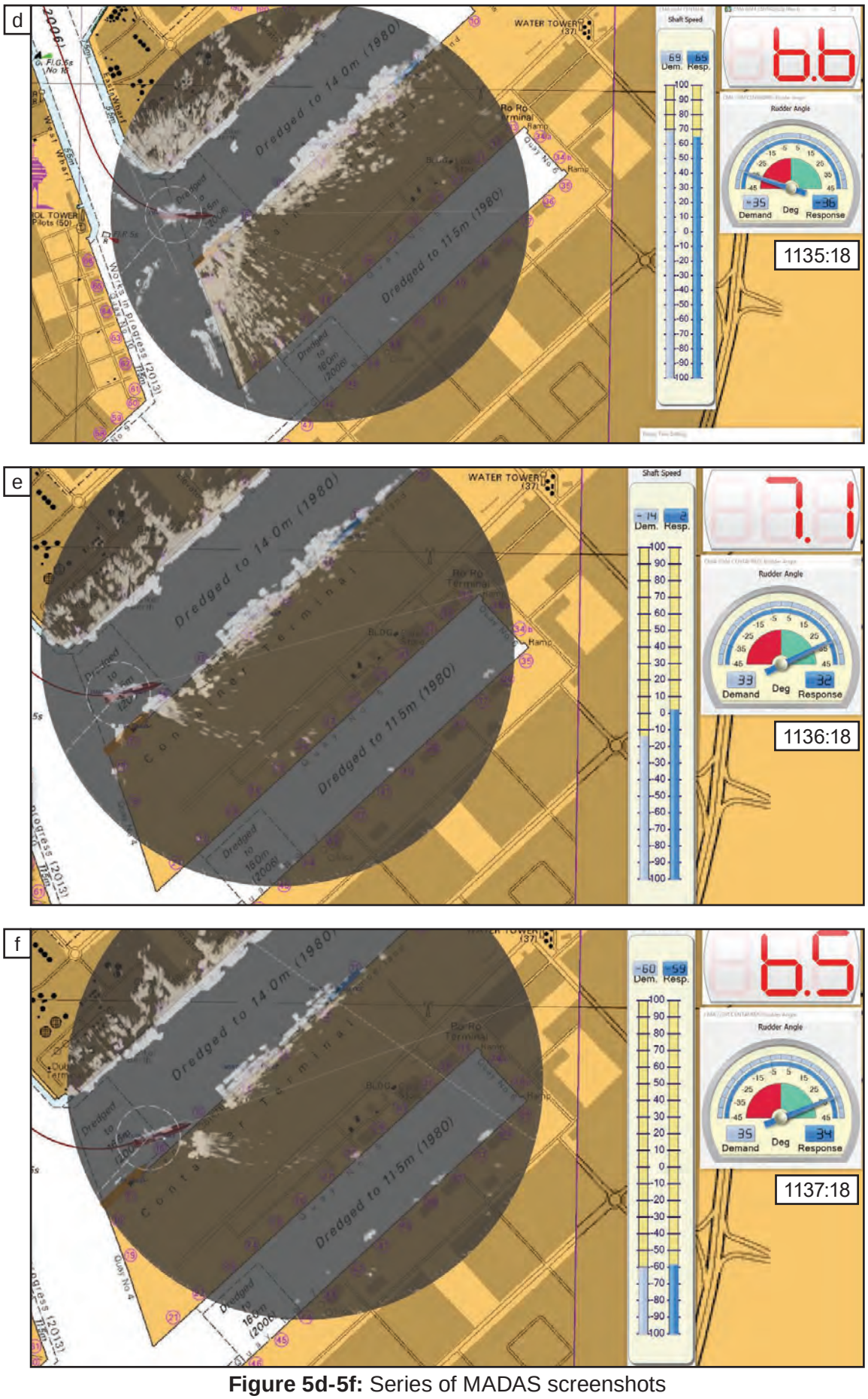

Figure 5d-5f: Series of MADAS screenshots

The pilot then ordered 'stop engines', and then in quick succession 'slow astern', 'half astern' and 'full astern'. The pilot ordered 'amidships' and, 30 seconds later, 'hard to starboard', resulting in *CMA CGM Centaurus*'s stern clearing *NYK Crane*.

At 1137:16, the pilot ordered "*Let go port anchor*". However, recognising that a heavy contact with the quay was imminent, the forecastle crew had already moved aft and so were unable to effect the pilot's order.

At 1137:55, the bulbous bow of *CMA CGM Centaurus* made contact with a spacer pontoon[2] on Berth 15 at a speed of 5.3kts **(Figure 6)**. The ship then heeled to starboard and struck two shore cranes **(Figure 7)**. One of the cranes immediately collapsed, and several containers fell from the ship onto the quay as a result of the impact **(Figure 8)**.

Following the accident, with tug assistance, *CMA CGM Centaurus* was manoeuvred to the centre of the basin. Another pilot boarded and the ship was manoeuvred onto a lay-by berth to allow the resulting damage to be assessed.

1.3 CONSEQUENCES

1.3.1 Damage to *CMA CGM Centaurus*

CMA CGM Centaurus's bulbous bow was displaced to port. The starboard bow's shell plating was holed 2 metres above the waterline and there was significant structural damage to the starboard side of the forward mooring deck, the fore peak tank and the ship's starboard quarter. Temporary repairs were carried out in Jebel Ali to the satisfaction of the ship's classification society before it was permitted to complete its scheduled port calls. The ship then returned to Singapore and was taken out of service for permanent repairs.

1.3.2 Damage to port infrastructure and injuries to shore personnel

Two shore cranes were structurally damaged. One crane was removed from its tracks by the impact. The second crane collapsed completely, narrowly missing an occupied office building **(Figure 9)**, which was structurally damaged as a result of the accident.

A spacer pontoon and 10 quay fenders sustained damage, one mooring bollard was displaced, and several port vehicles were damaged.

Ten port employees sustained injuries as a result of the accident. The most seriously injured sustained a broken arm and a broken leg.

1.4 ENVIRONMENTAL CONDITIONS

At the time of the accident, the wind was north-north-east, force 3. It was a fine sunny day with good visibility and an air temperature of 39ºC.There was a negligible tidal stream.

[2] Spacer pontoons had been placed alongside Berth 15 in anticipation of *CMA CGM Centaurus*'s arrival. While the basin was dredged to 16.5m, there was less depth available directly alongside the berths, thus spacer pontoons were used to keep deep-draught vessels a distance of 2 metres from the quay.

Figure 6: *CMA CGM Centaurus* making contact with the quay

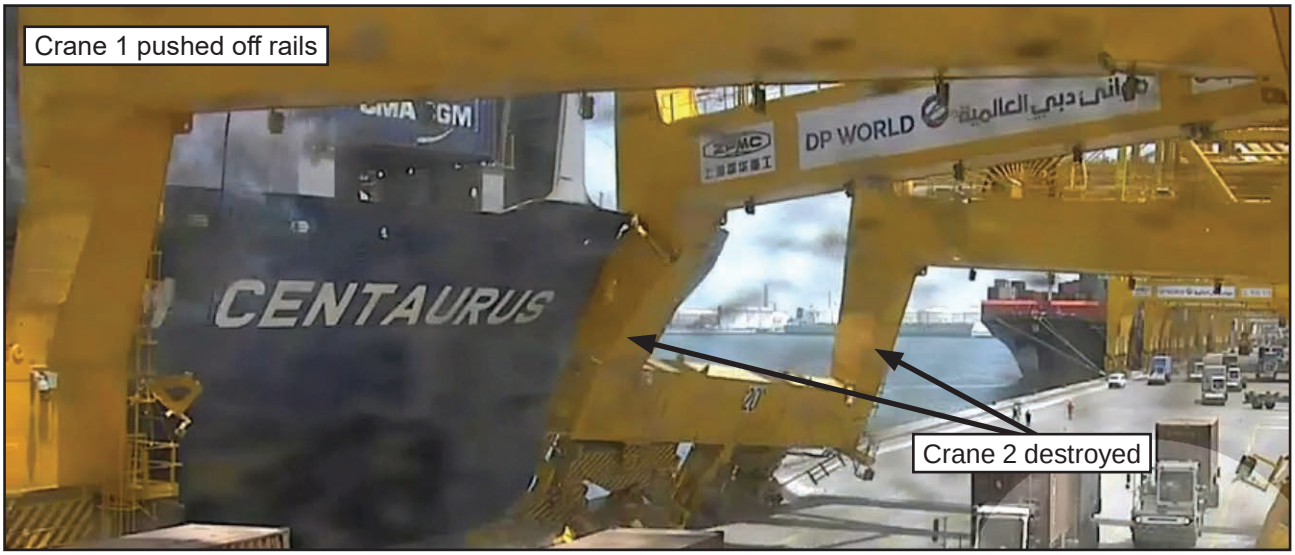

Figure 7: *CMA CGM Centaurus* making contact with two shore cranes

Figure 8: Containers falling from ship onto the quay

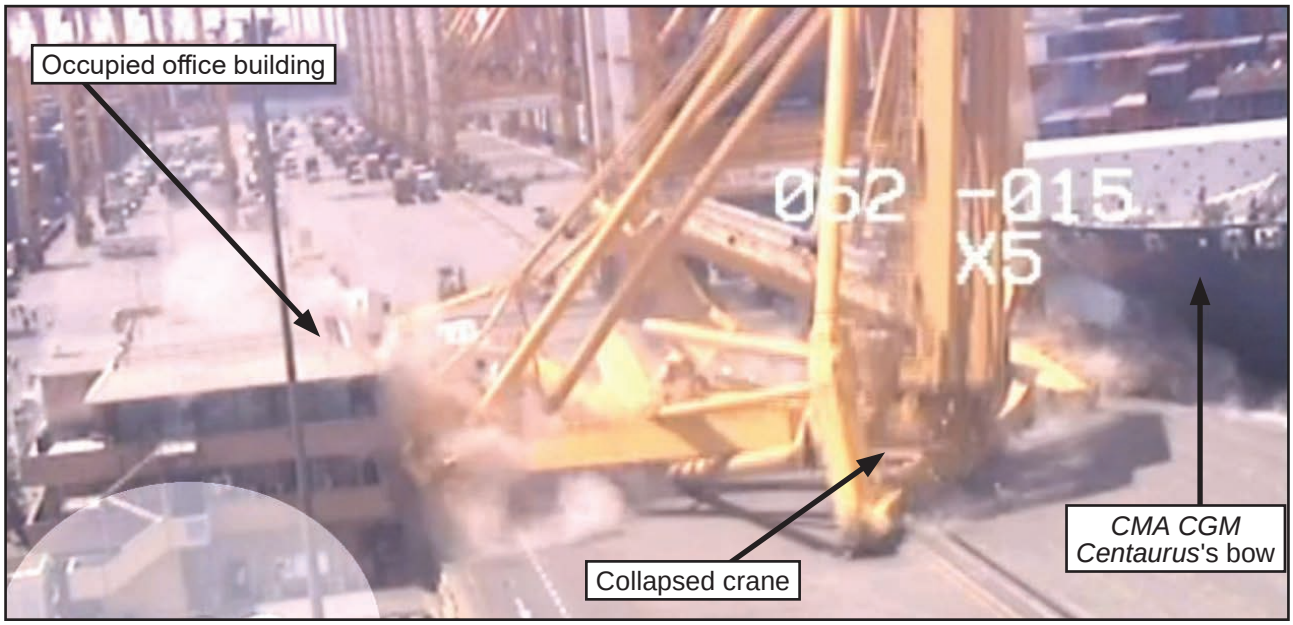

Figure 9: Crane collapsing in close proximity to an occupied office building

1.5 *CMA CGM CENTAURUS*

1.5.1 General ship information

CMA CGM Centaurus was a UK registered container ship of 131,332 gross tonnage and 363.61m length overall. The ship was built in Korea in 2010 and was one of a class of 12 ships built for the CMA CGM Group.

CMA CGM Centaurus was engaged on CMA CGM's China Middle East Express (Cimex 3) liner service, linking ports in China with ports in the Middle East **(Figure 10)**. The service was a 49-day round trip from Singapore and included nine scheduled port calls. *CMA CGM Centaurus* was classed by Bureau Veritas. It had a cargo-carrying capacity of 11,400 TEU[3] and, at the time of the accident, had an even keel laden draught of 15.52m. A replacement bulbous bow had been fitted in August 2015 to provide a narrower profile aimed at reducing fuel consumption at slow speed.

1.5.2 Propulsion machinery and steering gear

CMA CGM Centaurus was fitted with a single 2-stroke slow speed diesel main engine driving a 6-blade, right-handed, fixed pitched propeller. The main engine was controlled from the bridge telegraph via an electronic load management system, and provided a service speed of 23kts. Steerage was effected by means of a semi-balanced hanging rudder with a maximum angle of 35º, and the ship was additionally equipped with a 3,000kW bow thruster.

1.5.3 Bridge equipment

CMA CGM Centaurus's bridge equipment included X- and S-band radars. Vectors, indicating the ship's direction of travel, were displayed on the radar screens. The primary means of navigation was paper charts. *CMA CGM Centaurus* was equipped

[3] TEU – twenty foot equivalent unit. A measure of container ship cargo-carrying capacity.

Figure 10: CMA CGM Cimex 3 route

with an ECDIS[4], though it was not in use at the time of the accident as its chart licence had expired. All other bridge equipment **(Figure 4)**, including speed logs, depth indicators, AIS[5] and GPS[6] receivers was operational and functioning as designed.

1.5.4 Crew

CMA CGM Centaurus had a crew of 27. The officers were from Croatia and Montenegro, and the ratings were Romanian. There were two deck cadets, who were Chinese nationals.

The ship's working language was English.

The master was 55 years old and held a Croatian STCW[7] II/2 Master's Certificate of Competency (CoC). He had been recruited by CMA CGM as a cadet in 1985 and, following interim advances in rank, was promoted to master in 2007. His contracted work agreement was for 3 months' service on board followed by 3 months' leave. It was his first contract on *CMA CGM Centaurus*, having completed several contracts as master on a sister vessel, *CMA CGM Titan*. He had visited Jebel Ali on several occasions, but all previous visits had been to Terminal 3. He had joined the ship on 20 March 2017.

The master had attended the following relevant training courses:

- Ship handling – advanced, manned models – August 2014
- Maritime resource management – June 2014
- Passage planning navigation and watchkeeping – August 2013

[4] Electronic Chart Display and Information System.

[5] Automatic Identification System.

[6] Global Positioning System.

[7] STCW – International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978, as amended.

- Ship handling – simulator training for VLCS[8] over 334m length – July 2013
- Ship handling – advanced, manned models – July 2009.

The chief officer was 57 years old and held a Croatian STCW II/2 Chief Mate's CoC. He had worked as a chief officer on container ships operated by CMA Ships for 10 years, and had previously served as chief officer on *CMA CGM Centaurus* in 2013. He had visited Jebel Ali before, but not to Terminal 1. His contract was for a period of 4 months' service on board followed by 2 months' leave. He had joined the ship on 28 February 2017.

The chief officer had attended the following relevant training courses:

- Ship handling – bridge simulator level 4 – April 2015
- Maritime resource management – November 2015
- Passage planning navigation and watchkeeping – March 2015
- Ship handling – simulator training for VLCS over 334m length – September 2014
- Ship handling – advanced, manned models – September 2013.

The helmsman was 58 years old and was at the end of a 6-month contract.

The deck cadet who was on the bridge at the time of the accident was 25 years old. It was his first trip to sea, and he had joined the ship on 19 November 2016.

1.5.5 Manoeuvring information

IMO Resolution A.601(15) – Provision and display of manoeuvring information on board ships – was adopted on 19 November 1987 and recommends Administrations to require that manoeuvring information is on board ships and available to navigators.

Marine Guidance Note (MGN) 301(M+F) – Manoeuvring Information on Board Ships – was published by the UK Maritime and Coastguard Agency (MCA) in November 2005. It reflects the contents of IMO Resolution A.601(15) and recommends that manoeuvring information in the form of a pilot card, wheelhouse poster and manoeuvring booklet should be provided on board ships.

- Pilot card

  'The pilot card, to be filled in by the master, is intended to provide information to the pilot on boarding the ship. This information should describe the current condition of the ship, with regard to its loading, propulsion and manoeuvring equipment, and other relevant equipment.

  Note: The information provided in the pilot card should be available without the need to conduct special manoeuvring trials.'

[8] Very Large Container Ship

- Wheelhouse poster

  'The wheelhouse poster should be permanently displayed in the wheelhouse. It should contain general particulars and detailed information describing the manoeuvring characteristics of the ship, and be of such a size to ensure ease of use.

  Note: The manoeuvring characteristics may be determined by conducting special manoeuvring trials or by computer simulation techniques or by estimation. The master should bear in mind that the manoeuvring performance of the ship may differ from that shown on the poster due to environmental, hull and loading conditions.'

- Manoeuvring booklet

  'The manoeuvring booklet should be available on board and should contain comprehensive details of the ship's manoeuvring characteristics and other relevant data. The manoeuvring booklet should include the information shown on the wheelhouse poster together with other available manoeuvring information.

  Note: Most of the manoeuvring information in the booklet can be estimated but some should be obtained from trials.'

Appendix 3 of MGN 301(M+F) recommends the following information to be included in the manoeuvring booklet in respect of manoeuvring characteristics in shallow water:

'4.1 Turning circle in shallow water (estimated)

4.1.1 Turning circle in the full load condition (stern track to be shown)

4.1.2 The initial speed of the ship should be half ahead

4.1.3 Times and speeds at 90º, 180º, 270º and 360º turning should be specifically shown, together with an outline of the ship

4.1.4 The rudder angle should be the maximum and the water depth to draught ratio should be 1.2

4.2 Squat (estimated)

4.2.1 Curves should be drawn for shallow water and infinite width of channel, indicating the maximum squat versus ship speed for various water depth/draught ratios

4.2.2 Curves should be drawn for shallow and confined water, indicating the maximum squat versus speed for different blockage factors.'

CMA CGM Centaurus's pilot card **(Annex A)** was provided to the pilot during the master/pilot information exchange (MPX). The card was supplemented by a ship's particulars sheet and a bollard pull diagram, indicating the preferred tug pushing points and bollard safe working loads. Additional data was available on the

bridge manoeuvring poster **(Annex B)**, located on the aft bridge bulkhead. Further information was also available in a manoeuvring booklet, which was neither provided to nor requested by the pilot.

Maximum estimated squat effect was provided for under keel clearances (UKCs) of 3.10m and 7.75m at a ship's speed of 4, 6 and 8kts. The estimated maximum squat effect for a UKC of 3.10m at a ship's speed of 4 and 6kts was 0.073m and 0.179m respectively. The only turning data provided on board for the ship's loaded condition in shallow water was for a 'half ahead' speed of 12.2kts.

1.6 CMA CGM GROUP

1.6.1 Ownership and management

At the time of the accident, the CMA CGM Group owned a fleet of 171 container ships and operated a total fleet of 428 ships on a global network. The ships were divided into fleets and managed from various offices around the world by CMA Ships or by external technical management companies. *CMA CGM Centaurus* was part of Fleet 5 and was managed by CMA Ships, an internal management company based in the CMA CGM Group's headquarters in Marseille, France.

1.6.2 Safety management

The requirement for management companies to establish a safety management system (SMS) is laid out in the International Safety Management (ISM) Code. CMA Ships' Document of Compliance (DoC) was valid until December 2020. *CMA CGM Centaurus*'s Safety Management Certificate (SMC) was valid until October 2021. CMA Ships operated an Integrated Management System (IMS), which contained generic procedures that were created and approved by shore management and applicable to the whole company fleet.

The bridge manual formed part of the IMS and detailed the company's bridge procedures, checklists and navigational safety guidelines. The bridge manual contained detailed instructions for watchkeeping, bridge management, passage planning and pilot management.

1.7 JEBEL ALI

1.7.1 Overview

The port of Jebel Ali was situated approximately 20nm west of Dubai, UAE **(Figure 11)**. At the time of the accident, it was owned and operated by DP World UAE Region and was the largest marine terminal in the Middle East, with approximately 24,000 ship movements per year. It was also the flagship facility of DP World's portfolio of over 65 marine terminals across six continents. The port handled all ship types, including container, oil, gas, ro-ro cargo, naval and passenger ships.

There were three container terminals in Jebel Ali, namely Terminals 1, 2 and 3. The port could accommodate ships of up to 400m length and 16m draught. Pilotage services were provided by 44 pilots who were employed directly by DP World.

On 4 May 2017, there were nine tugs available in Jebel Ali, two of which were allocated to assist in berthing *CMA CGM Centaurus*. *Asad* and *Timrar* were both azimuth stern drive tugs with a bollard pull of 62.6 tonnes and 65.1 tonnes respectively.

Port instructions required a tug to be in attendance before an inbound ship passed the inner breakwater.

Figure 11: Aerial view of Terminal 1 Jebel Ali port

1.7.2 Vessel traffic management

Jebel Ali Port Control operated a Vessel Traffic Management (VTM) system to provide a communication link between ships, pilots and the port.

The system was aligned to, but did not meet all of, the Vessel Traffic Services (VTS) standards of the International Association of Marine Aids to Navigation and Lighthouse Authorities (IALA). DP World UAE Region had not formally declared its service as a VTS and it was not listed as such in the Admiralty List of Radio Signals Volume 6 (NP286(8)) or the World VTS Guide 5.

Jebel Ali Port Control, which was manned at all times by a senior pilot, purported to provide the following functions:

- '*Organise vessel traffic within the area of the ports jurisdiction, including the anchorage, in accordance with planned movements and the ports regulations.*
- *Communicate with vessels providing port information and traffic management.*

- *Transmit navigation and meteorological information to ships.*
- *Coordinate the use of the ports assets (Pilots, tugs and mooring parties) in conjunction with the duty pilots for the safe and efficient movement of traffic.*
- *Respond to emergency situations.*
- *Assist the marine department with arrival and departure planning.*' [sic]

1.7.3 Pilotage

Pilotage was compulsory in Jebel Ali for all vessels of 300 tonnes and over, with some approved exceptions.

Of the 44 pilots employed directly by DP World in Jebel Ali at the time of the accident, 36 were qualified to provide pilotage on ships the size of *CMA CGM Centaurus*. The pilots were multi-national and worked a 9-day duty cycle, with at least eight pilots available on any given day. Pilots were rostered to work an 8-hour shift. In each 9-day duty cycle a pilot was expected to work six 8-hour shifts. Pilots commenced their duty cycle by working two evening shifts, then two night shifts, then one day's rest followed by two morning shifts, and then two days' rest.

CMA CGM Centaurus's pilot was a 42-year-old Indian national. He held an STCW II/2 CoC issued in India. He began piloting in Jebel Ali in September 2014 and was authorised as an unrestricted pilot in May 2015. He had previously been a pilot in India for 4½ years before moving to Jebel Ali. Prior to becoming a pilot, he had served as master on gas carriers.

At the time of the accident, the pilot was on day 7 of his 9-day duty cycle. He had started work at 0700, and had completed one act of pilotage prior to embarking *CMA CGM Centaurus*, which was to be his last job before taking 2 days' rest.

The trainee pilot, a Yemeni national, had recently begun his pilotage training. He held an STCW II/2 Chief Officer CoC issued in Australia, and was on board *CMA CGM Centaurus* as an observer only.

1.7.4 Pilot recruitment and training

DP World aimed to recruit pilots who were qualified master mariners and had worked as marine pilots for a minimum of 5 years.

Following successful interview, newly employed pilots were familiarised with the port and its facilities. Initially, new pilots accompanied pilots carrying out acts of pilotage on a wide variety of ship types.

Following 1 month of familiarisation training, pilots began to carry out solo acts of pilotage on ships of 180-200m length overall.

Promotion to unlimited status was based on feedback from senior pilots; there was no formal examination process. Newly hired pilots were expected to attain unlimited status within 6 to 12 months of commencing employment.

Pilots did not specialise on a particular class of ship in Jebel Ali. All of the port's pilots were expected to have and maintain the required skills to conduct a safe passage on all types and sizes of ship using the port.

Newly employed pilots were not provided with any specific ship handling training as they had substantial previous experience. No bridge resource management training or refresher training was carried out as DP World expected all pilots to have previously attended BRM training while working at sea.

1.7.5 Ship assignment

Pilots were assigned their next act of pilotage by Jebel Ali Port Control and advised by VHF radio or telephone prior to disembarking an outbound ship or when reporting first line ashore on an inbound ship. Pilots frequently disembarked from an outbound ship and transferred directly via pilot launch to an inbound ship.

Port Control maintained a list of ships due to arrive and depart, and was kept updated by each of the terminals. It was Port Control's role to ensure that pilots were available either in the terminal, on the launch or at the pilot station. On average, pilots completed three acts of pilotage in any given 8-hour shift.

1.7.6 Pilotage key performance indicators

In a drive to monitor and improve efficiency within Jebel Ali, the port's management had introduced a number of Key Performance Indicators (KPIs) for all three terminals.

The KPI for completing an act of pilotage involved recording the time taken from pilot embarkation to first line ashore for inbound ships, or from all lines gone to pilot disembarkation for outbound ships.

Each ship type was allocated an average KPI duration for a manoeuvre to or from a particular terminal. Each act of pilotage was then compared to the average duration for the corresponding manoeuvre and ship type, and the results recorded.

For a container ship, inbound to Terminal 1, the KPI duration allocated for the act of pilotage in 2016 was 60 minutes. This value was reduced to 55 minutes for 2017.

An annual bonus payment to pilots was linked to the attainment of KPIs.

1.8 MASTER/PILOT RELATIONSHIP

1.8.1 Formal guidance

Guidance with respect to the master/pilot relationship is contained in, inter alia, IMO Resolution A.960, the International Chamber of Shipping's (ICS) Bridge Procedures Guide (BPG), and 'International Best Practices for Maritime Pilotage' jointly published by the ICS, Intertanko[9] and OCIMF[10].The law has traditionally considered

[9] Intertanko is a forum where the industry meets, policies are discussed and best practice developed. Its membership is open to independent tanker owners and operators of oil, chemical and gas tankers

[10] Oil Companies International Marine Forum

a marine pilot on board a ship '*conducting*' its navigation as the employee of the ship owner. IMO Resolution A.960 – Annex 2, Section 2 – Duties of master, bridge officers and pilot – includes the following extract:

> *'2.1 The pilot's presence on board does not relieve the master or officer in charge of the navigational watch from their duties and obligations for the safety of the ship. It is important that, upon boarding the ship and before pilotage commences, the pilot, master and other bridge personnel are aware of their respective roles in the safe passage of the ship.*
>
> *2.2 The master, bridge officers and pilot share a responsibility for good communications and understanding of each other's role for the safe conduct of the vessels in pilotage waters.*
>
> *2.3 Masters and bridge officers have a duty to support the pilot and to ensure that his/her actions are monitored at all times.'*

Chapter 5 of the ICS's BPG includes a diagrammatic example of the lines of communication, and lists the roles and responsibilities of the ship's bridge team and the pilot when a pilot is on board **(Annex C)**. The following are extracts:

> *'5.5 The master has ultimate responsibility for the safety of the ship and prevention of pollution. The Bridge Team is not relieved of its responsibility for safe navigation following embarkation of the Pilot… The Pilot should effectively communicate expert local knowledge, information and advice to the Bridge Team in English or a defined working language that is understood by the Master, Pilot and Bridge Team. Pilots should in turn be supported by all appropriate shipboard personnel in their execution of safe navigation.*
>
> *At all times it should be clearly understood by the Bridge team, including the Pilot, whether the Master, Pilot or OOW[11] has control of steering and propulsion.'*
>
> *'5.5.1 When deciding on the composition of the Bridge Team, consideration should be given to the need for sufficient resources to ensure that the following are effectively achieved:*
>
> - *'Operating navigation equipment and providing assistance and advice to the Pilot as necessary;*
> - *Monitoring the actions of the Pilot and other members of the Bridge Team;*
> - *Monitoring ship progress against the pilotage plan…;*
> - *Identifying misunderstandings and ensuring that clarifications are sought immediately if in any doubt…'*

The ICS, Intertanko and OCIMF publication: 'International Best Practices for Maritime Pilotage' includes the following extract:

> *'1.1 Efficient pilotage is chiefly dependent on the effectiveness of the communications and information exchanges between the pilot, the master and other bridge personnel and upon the mutual understanding each has for*

[11] Officer of the Watch

the functions and duties of the others. Ship's personnel, shore based ship management and the relevant port and pilotage authorities should utilise the proven concept of 'Bridge Team Management'. Establishment and effective co-ordination between the systems and the equipment available to the pilot is a prerequisite for the safe conduct of the ship through pilotage waters.'

1.8.2 MAIIF/IMPA poster

The Marine Accident Investigators' International Forum (MAIIF) and the International Maritime Pilots' Association (IMPA) have jointly published a poster **(Annex D)**. The poster is designed to highlight the importance of sharing information between the ship's bridge team and the pilot, respecting each other's role, communicating throughout the pilotage, working together and staying alert.

1.8.3 CMA Ships' procedures for pilot management

The marine procedures for pilot management in CMA Ships' SMS **(Annex E)** were intended to facilitate the integration of pilots into the bridge team, standardise information exchange and set effective communication rules on the bridge. The procedures stated that a pilot's presence on board did not absolve the master or the OOW from their duties and obligations for the safety of the ship or pollution prevention.

1.9 PASSAGE PLANNING

1.9.1 General

Prior to proceeding to sea, masters are required[12] to ensure that the intended voyage has been planned using appropriate nautical charts and nautical publications for the area concerned, taking into account the guidelines and recommendations developed by the IMO. The IMO's guidelines and recommendations are set out in its Resolution A.893(21) – Guidelines for Voyage Planning. The IMO guidelines explain the importance of voyage (passage) planning and the continuous monitoring of a ship's progress and position during the execution of the plan from berth-to-berth.

More detailed information and guidance on passage planning is provided by the ICS BPG, which states[13] :

'2.1 The purpose of passage planning is to develop a comprehensive navigation plan for the safe conduct of the ship from berth to berth…'

Chapter 5 of the BPG acknowledges that it may be impractical to include all details in the passage plan prior to departure, particularly some of those relating to arrival, but emphasises the need for the plan to be finalised as soon as practicable, viz:

'5.2.1 Appraisal and planning of a berth to berth passage plan should include the completion and approval by the Master of a pilotage plan... The pilotage plan may not be complete until after the Master/Pilot information exchange (MPX) has taken place...'

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[12] SOLAS Regulation 34 – Safe Navigation and Avoidance of Dangerous Situations

[13] Chapter 2 section 2.1

1.9.2 CMA Ships' procedures for passage planning

The passage planning guidance contained within the CMA Ships SMS **(Annex F)** was similar to that contained in IMO Resolution A.893(21) and the BPG.

To assist in the preparation of pilotage plans, CMA Ships also provided its fleet with port cards containing information related to entry and berthing in a port. The port cards had been developed by the company's masters and were regularly updated. The port card for Jebel Ali **(Annex G)** was included with the passage plan for the voyage, and contained guidance on the environment, approaches/point of no return, pilotage, tugs and berthing details. The port card acknowledged that pilots could board in the buoyed channel and stated that the speed limit in the harbour was 8-10kts. It contained some guidance about swinging off some berths in Terminals 2 and 3, but none for Terminal 1.

CMA CGM Centaurus did not have a berth-to-berth passage plan. The track line marked on the paper chart ended in the channel. Neither the ship's team nor the pilot had prepared a pilotage plan.

1.10 MASTER/PILOT INFORMATION EXCHANGE

1.10.1 Formal guidance

'International Best Practices for Maritime Pilotage' lists a number of factors to be considered in an MPX, including navigational intentions and contingency planning, and states:

> *'3.2 After taking this information into account and comparing the pilot's suggested plan with that initially developed on board, the pilot and master should agree an overall final plan early in the passage before the ship is committed. The master should not commit his ship to the passage until satisfied with the plan. All members of the bridge team should be made aware of the plan such that the whole bridge team have a shared understanding of the passage plan. All parties should be aware that elements of the plan may change.'*

IMO resolution A.960 - Recommendations on training and certification and operational procedures for maritime pilots other than deep-sea pilots – Annex 2 - Section 5 - Master-pilot information exchange states:

> *'5.2 Each pilotage assignment should begin with an information exchange between the pilot and master. The amount and subject matter of the information to be exchanged should be determined by specific navigation demands of the pilotage operation. Additional information can be exchanged as the operation proceeds.'*
>
> *'5.5 It should be clearly understood that any passage plan is a basic indication of preferred intention and both the pilot and the master should be prepared to depart from it when circumstances so dictate.'*

The resolution also clarifies the importance of and what should be included in the MPX.

The ICS BPG includes the following extract:

> *'5.3.1 To allow sufficient time for a comprehensive MPX, the ship should ensure that it is available to embark the Pilot at the agreed embarkation time. Any delays in embarkation may reduce the time available for a comprehensive MPX and to make and agree any necessary amendment to the pilotage plan.'*

1.10.2 CMA Ships' policy

Detailed instructions for the conduct of the MPX were contained in CMA Ships' marine procedures for pilot management (Annex E), which included:

> *'On pilot arrival on the bridge the Master must lead a briefing with the pilot addressing the following points:*
>
> - *Bridge team management during the passage:*
> - *Duties and responsibilities of the Master;*
> - *Duties of the Pilot;*
> - *Duties of the OOW;*
> - *Duties of the OOWA[14] (if applicable);*
> - *Coning method: OOW with Pilot recommendations under Master supervision / Master with Pilot recommendations / Pilot under Master supervision;* [sic]
> - *Use of English language on the bridge, use of SMCP[15];*
> - *Language with external radio stations (Tugs, VTS, Line handlers…). If not English, the Master must make clear with the pilot he will be explained all orders in advance.*
> - *Presentation and Signature of the Pilot Card;*
> - *Unusual ship-handling characteristics, machinery difficulties, navigational equipment problems or crew limitations that could affect the operation, handling or safe manoeuvring of the ship;*
> - *Any impacting Company Regulation (e.g: UKC policy, Port Card Company regulation…)'*

The procedure stated an expectation that the pilot would provide a 'pilot passage and manoeuvring plan'. Taking the pilot's suggested plan and the ship's provisional pilotage plan into account, the master was expected to agree a final plan and brief the bridge team prior to committing to the pilotage.

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[14] OOWA – officer of the watch assistant

[15] SMCP – Standard Marine Communication Phrases. Adopted by IMO resolution A.918(22)

The initial MPX on board *CMA CGM Centaurus* confirmed only the berth allocation, number of tugs to be utilised and the mooring sequence. No manoeuvring plan, speeds or turning points were discussed, nor was there any discussion in regards to when and how the tugs would be utilised or whether other traffic would impact on the inward passage. The MPX did not include any discussion on the allocation of specific roles within the bridge team.

1.11 THE TURN INTO THE BASIN

The pilot had previously manoeuvred ships with a deep draught similar to that of *CMA CGM Centaurus* into the Terminal 1 basin using one of two methods. He had either turned the ship directly from the channel into the basin or stopped the ship in the channel and then manoeuvred it stern-first into the basin.

He preferred the former method and, although he had not previously attempted the turn on a ship as large as *CMA CGM Centaurus*, he was confident from his previous experience that the manoeuvre could be completed safely at a starting speed of 4.5kts. Consequently, the pilot intended to start the turn at that speed.

After the accident, MAIB inspectors, assisted by company staff, carried out a series of manoeuvring trials at CMA CGM Academy's bridge simulator training centre in Marseille.

Using position and speed data from *CMA CGM Centaurus*'s voyage data recorder (VDR) and a full mission bridge simulator incorporating a model of the ship and a model of Jebel Ali port, a simulated reconstruction of the manoeuvre confirmed that *CMA CGM Centaurus* could not successfully complete the turn if the turn was commenced at 6.3kts.

Further simulations showed that a direct turn into the basin was achievable without tug assistance, if the turn was started at a ship's speed of up to 4kts and the bow thruster on full power to port.

1.12 SHIP MANOEUVRING

1.12.1 Turning ability

The Rate of Turn (ROT) that a ship can achieve is largely determined by its design characteristics, draught/air draught, speed, and rudder angle. ROT is also affected by environmental conditions acting on the ship, such as strength and direction of wind and tidal stream, and its under keel clearance.

Ships move laterally when turning because the pivot point[16] is not located at the ship's centre. When moving forward and turning to port, the ship's lateral movement is to starboard. A ship's turning circle is determined by a combination of its ROT and lateral movement.

A bow thruster can be effective in increasing a ship's turning ability. However, its efficiency is adversely affected by the turbulence caused by water flow across the bow thruster tunnel entrance. Bow thruster performance will reduce when the ship's speed through the water increases above 2kts, and most bow thrusters will be

[16] Pivot point – The point about which a ship rotates. When moving ahead the pivot point normally lies between ¼ and ⅓ of the ship's length from the bow.

ineffective at a speed of more than 5kts. Bow thruster performance will also reduce when a ship is making headway because the distance between the bow thruster and the pivot point decreases creating a reduced turning moment.

1.12.2 Hydrodynamic interaction

A ship's turning ability can be significantly reduced by the effects of hydrodynamic interaction. MGN 199(M) – Dangers of interaction – draws attention to the effects of hydrodynamic interaction on vessel manoeuvrability and includes the following advice:

'It should be noted that in dealing with an interaction situation the control of the vessel depends on the rudder which in turn depends on the flow of water round it…In many cases a momentary increase of propeller revolutions when going ahead can materially improve control.'

'Squat is a serious problem for vessels which have to operate with small under-keel clearances, particularly when in a shallow channel confined by sandbanks or by the sides of a canal or river…'

'The effectiveness of the rudder is reduced in shallow water, and depends very much on adequate propeller speed when going ahead. The minimum revolutions needed to maintain steerage way may therefore be higher than are required in deep water.'

'However, relatively high speeds in very shallow water must be avoided due to the danger of grounding because of squat. An increase in draught of well over 10% has been observed at speeds of about 10 knots, but when speed is reduced squat rapidly diminishes…'

'Vessels may therefore experience quite marked changes in their manoeuvring characteristics as the depth of water under the keel changes. In particular, when the under-keel clearance is very small a marked loss of turning ability is likely.'

'The towing power of a tug can be reduced or even cancelled when assisting a larger vessel with small under-keel clearance on a short towline.'

1.12.3 Use of tugs

The use of appropriate tugs can assist greatly in manoeuvring large container ships in the confines of a port by enhancing a ship's turning ability. Tugs employed at the forward and aft ends of a ship are more effective when the ship is stopped or making little headway. This is because the ship's pivot point is then normally close to amidships and the danger of hydrodynamic interaction is minimal, thereby maximising the available power of each tug to assist in turning the ship.

It was general practice on *CMA CGM Centaurus* to use two tugs for arrival and departure manoeuvres in port.

1.12.4 Manoeuvring competence

STCW specifies a minimum standard of competence for masters and chief mates on ships of 500 gross tonnage or more. The specification requires competence in manoeuvring and handling a ship in all conditions to be demonstrated through

examination and assessment of evidence collected from one or more of approved in-service experience, approved simulator training or approved manned scale ship model training.

For evaluating the above competence, STCW requires the following criteria to be used:

> *'All decisions concerning berthing and anchoring are based on a proper assessment of the ship's manoeuvring and engine characteristics and the forces to be expected while berthed alongside or lying at anchor.*
> *While under way, a full assessment is made of possible effects of shallow and restricted waters, ice, banks, tidal conditions, passing ships and own ship's bow and stern wave so that the ship can be safely manoeuvred under various conditions of loading and weather.'*

1.13 BRIDGE RESOURCE MANAGEMENT

1.13.1 General

Bridge resource management (BRM) is the effective management and use of all available resources, both human and electronic, by the bridge team to ensure the safe navigation of a ship. The essence of BRM is a safety culture and management approach that facilitates communication, co-operation, and co-ordination among the individuals involved in a ship's navigation.

BRM incorporates concepts such as workload management, problem-solving, decision-making, communication and teamwork.

The ICS BPG provides detailed guidance on effective bridge organisation and BRM, and states:

> *'1.1 …An effective Bridge Team will manage efficiently all the resources that are available and promote good communication and teamwork…''*

CMA Ships' bridge manual contained instructions and guidance aimed at promoting BRM. The master and chief officer of *CMA CGM Centaurus* had received BRM training in the form of maritime resource management training in June 2014 and November 2015 respectively.

STCW requires all officers in charge of a navigational watch on ships of 500 gross tonnage or more to be competent in BRM. The competence is to be demonstrated through examination and assessment of evidence obtained from one or more of approved training, approved in-service experience or approved simulator training. This requirement became mandatory in 2012.

For evaluating the above competence with specific reference to pilotage, STCW requires the following criterion to be used:

> *'Responsibility for the safety of navigation is clearly defined at all times, including periods when the master is on the bridge and while under pilotage.'*

A further STCW requirement that became mandatory in 2012 is for masters and chief mates on ships of 500 gross tonnage or more to be competent in the use of leadership and managerial skill. The competence is to be demonstrated

through assessment of evidence obtained from one or more of approved training, approved in-service experience or approved simulator training. To obtain a UK STCW II/2 CoC, a candidate must submit a completion certificate in respect of a Human Element and Leadership and Management (HELM) training course, which aims to provide the leadership and management skills required by STCW. The criteria required to be used for evaluating the above competence make no specific reference to BRM.

1.13.2 Bridge resource management training for pilots

IMO Resolution A.960 Annex 1 - Section 5.3 states:

> *'Every pilot should be trained in bridge resource management with an emphasis on the exchange of information that is essential to a safe transit. This training should include a requirement for the pilot to assess particular situations and to conduct an exchange of information with the master and/or officer in charge of navigational watch. Maintaining an effective working relationship between the pilot and the bridge team in both routine and emergency conditions should be covered in training. Emergency conditions should include loss of steering, loss of propulsion, and failures of radar, vital systems and automation, in a narrow channel or fairway.'*

Section 5.5 and sub-section 5.5.4 state:

> *'Competent pilotage authorities should be encouraged to provide updating and refresher training conducted for certified or licensed pilots to ensure the continuation of their proficiency and updating of their knowledge, and could include the following;*
>
> > *.4 refresher or renewal courses in bridge resource management for pilots to facilitate communication and information exchange between the pilot and the master and to increase efficiency on the bridge.'*

The Guide to Good Practice on Port Marine Operations prepared in conjunction with the Port Marine Safety Code 2016 states:

> *'9.3.4 In order to work effectively with the bridge team, the pilot should be trained in the principles of both Bridge Team Management (the focus being internal and external relationships and operational tasks of the Bridge Team) and Marine Resource Management (the focus being cultural issues and the role of the pilot).'*

In recognition of the above guidance, various institutions and training providers, including some pilotage organisations, provide their own resource management training aimed specifically at the needs of pilots, often called 'BRM-P'.

1.14 PILOTAGE INDUSTRY RESEARCH

As part of this investigation, MAIB inspectors consulted pilotage associations and senior pilots familiar with pilotage operations involving large container ships in UK and north-west European ports.

Topics discussed included manoeuvring large container ships, use of tugs, pilots' expectations on boarding, berth-to-berth passage planning, MPX and bridge resource management training for pilots. This research identified that:

- Pilots boarding large container ships were routinely not provided with a pilotage passage plan prepared by the ship's bridge team.
- Pilots were generally very comfortable in their role and, while recognising that the ship's team had a duty to support the pilot, that support was often neither forthcoming nor requested by the pilot.
- Pilots who had received BRM-P training saw value in having done so.
- Pilots had very little time to assess the competence of the ship's bridge team after boarding a ship, and, in their experience, the competence of ships' bridge teams varied significantly.

They also confirmed that it was normal practice after boarding for the pilot to take conduct of a large container ship, and to retain conduct of the ship for berthing and unberthing operations.

1.15 PREVIOUS ACCIDENTS

1.15.1 MAIB reports

Sea Empress (MAIB Report 1996[17])

On 15 February 1995, the motor tanker *Sea Empress*, loaded with a cargo of 130,018 tonnes of Forties light crude oil, grounded off the Middle Channel Rocks in the approaches to Milford Haven. A pilot was on board and the ship was entering the Haven via the West Channel. Although the main engine was stopped, put astern and both anchors dropped, the ship continued to run ahead and came to rest aground, approximately 5 cables north-east of the initial grounding position. The weather was fine and clear with a west-north-westerly force 4/5 wind.

The investigation found:

- The master omitted to discuss the prepared ship's approach plan with the pilot and finalise it with him. This should have been done before the pilot took the con and need only have taken a few minutes.

Skagern/Samskip Courier (MAIB Report 6/2007[18])

On 7 June 2006, the general cargo ship *Skagern* and the container ship *Samskip Courier* collided in the Humber estuary in dense fog. Both ships had experienced pilots on board at the time of the accident.

[17] https://www.gov.uk/maib-reports/grounding-of-oil-tanker-sea-empress-in-the-approaches-to-milford-haven-wales-and-the-subsequent-salvage-operation

[18] https://www.gov.uk/maib-reports/collision-between-general-cargo-vessel-skagern-and-container-vessel-samskip-courier-in-the-humber-estuary-england

The investigation found:

- An omission to apply long established collision avoidance methods by the masters and pilots.
- Poor pilot/master relationships.
- Masters' reliance on the pilots and poor interaction and communications among the bridge teams.

Sea Mithril (MAIB Report 16/2008[19])

On 18 February 2008, the UK registered cargo ship *Sea Mithril* grounded in the River Trent on three occasions. A river pilot was embarked and dense fog had reduced visibility to about 20m.

The investigation found:

- The master was unable to maintain a command overview of the ship's passage.
- The master relied totally on the pilot for the safe navigation of his ship.
- Communication and co-ordination between the master and pilot prior to the groundings were poor.
- The pilot was not supported by the bridge organisation, which became dysfunctional after restricted visibility was encountered.
- Flaws in the bridge organisation and available support were not identified by the master or the pilot.

Vallermosa (MAIB Report 23/2009[20])

On 25 February 2009, the oil product and chemical tanker *Vallermosa*, loaded with a full cargo of 35,000t of jet fuel and bound for the BP Hamble Terminal in Southampton Water, made contact with two oil tankers that were discharging alongside at Fawley Marine Terminal. The accident caused structural damage to all three ships, minor damage to the jetty and minor pollution.

The investigation found:

- *Vallermosa*'s approach was unnecessarily aborted for administrative reasons.
- The pilot's effectiveness was reduced due to his heightened workload, frustration and increasing stress.
- The master and bridge team were not monitoring the pilot's actions sufficiently, despite their obligation to ensure the ship's safety.

[19] https://www.gov.uk/maib-reports/grounding-on-3-occasions-while-general-cargo-vessel-sea-mithril-was-approaching-grove-port-on-the-river-trent-england

[20] https://www.gov.uk/maib-reports/contact-made-by-product-tanker-vallermosa-with-oil-tankers-navion-fennia-and-bw-orinoco-at-fawley-marine-terminal-southampton-england

CMA CGM Vasco de Gama (MAIB Report 23/2017[21])

On 22 August 2016, the 399m long ultra-large container ship CMA CGM Vasco de Gama grounded on the western side of Thorn Channel when approaching the Port of Southampton. The ship was the largest UK-flagged vessel at the time and had two of the port's specialist container ship pilots on board.

The ship ran aground on a rising tide and on a flat shingle/sand seabed. A combination of tugs and ship's engines enabled it to be re-floated soon after grounding.

The investigation found:

- The ship's bridge team and the port's pilots had the experience, knowledge and resources available to plan and execute the passage effectively. However, the standards of navigation, communication and use of the electronic charting aids on board did not meet the expectations of the port or the company.

- A detailed plan had not been produced; the lead pilot had not briefed his plan for the turn round Bramble Bank; the bridge team's roles and responsibilities were unclear. There was an absence of a shared understanding of the pilot's intentions for passing other vessels, or for making the critical turns during the passage.

- The increasing size of vessels within restricted waterways, is leading to reduced margins of operational safety, and therefore the importance of proper planning and monitoring of the passage cannot be over-emphasised.

1.15.2 Further incidents

Recent container ship groundings with potentially serious consequences include:

18 April 2015 – *Susan Maersk* grounded in the Suez Canal

3 February 2016 – *CSCL Indian Ocean* grounded on the River Elbe

13 February 2016 – *APL Vanda* grounded on arrival Southampton

22 April 2016 – *CMA CGM Vasco de Gama* grounded on arrival Southampton

28 April 2016 – *MSC Fabiola* grounded in the Suez Canal

6 July 2016 – *Maersk Shams* grounded in the Suez Canal

6 December 2016 – *MSC Emanuela* grounded departing Jebel Ali, UAE

14 August 2017 – *CSCL Jupiter* grounded off Antwerp

10 October 2017 – *MSC Ines* grounded in Durban.

[21] https://www.gov.uk/maib-reports/grounding-of-the-ultra-large-container-vessel-cma-cgm-vasco-de-gama

SECTION 2 - ANALYSIS

2.1 AIM

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

2.2 THE PILOT'S ACTIONS

2.2.1 Choice of manoeuvre

Based on his previous experience of manoeuvring ships with a deep draught similar to that of *CMA CGM Centaurus*, the pilot preferred to turn ships directly into the Terminal 1 basin rather than to stop them in the channel and manoeuvre them into the basin stern-first. However, he had never carried out the manoeuvre on a ship quite as large as *CMA CGM Centaurus*, prompting him to ask the master whether the ship was 'good turning'. When he received the reply "*She is, but maybe she's heavy*", he decided to assess for himself how the ship manoeuvred before choosing which approach to adopt.

Having told the trainee pilot at 1102 that he would decide whether or not to turn directly into the basin once he had seen how the ship turned, at 1107, without any intervening course alteration, the pilot informed the pilot on *Emirates Dana* that *CMA CGM Centaurus* would be turning into the basin.

2.2.2 Start of the turn

Simulator trials confirmed that *CMA CGM Centaurus* would not achieve the ROT necessary to successfully turn into the Terminal 1 basin if the turn was commenced at a speed of 6.3kts. Based on his previous experience, the pilot was aware that a ship's speed of 4.5kts at the start of the turn would likely be successful: post-accident analysis confirmed *CMA CGM Centaurus* could complete the turn without tug assistance if it was commenced at speeds of up to 4kts and with the bow thruster pushing at full power to port.

Between 1102 and 1129:47, when he commenced turning *CMA CGM Centaurus* into the Terminal 1 basin, the pilot adjusted the ship's speed five times. Initially he reduced the ship's speed in a succession of steps down to 'dead slow ahead' so tug *Asad* could make fast forward. Once this was complete, at 1122, he increased speed by ordering 'slow ahead'. Then, at 1125:46 he again ordered 'dead slow ahead' before setting the VRM to 2 ship's lengths so he could judge when to commence the turn. The pilot was aware that *CMA CGM Centaurus* might have been travelling a little faster than he would have liked, but was content that the ship would make the turn when he ordered 'port 20°' at 1129:47. Following the accident, he expressed surprise on learning that the ship had been making 6.3kts when he ordered the turn.

The pilot's actions in the period before the turn at 1129:47 indicate that he was monitoring *CMA CGM Centaurus*'s speed, and he had taken effective action to slow the ship so tug *Asad* could attach. However, his assessment that *CMA CGM Centaurus* could turn safely into the Terminal 1 basin at 4.5kts was 0.5kt faster than the maximum achievable speed established during post-accident analysis, and he

was content that the ship might have been travelling a little faster than he wanted. The pilot did not appreciate that the additional speed would prevent the turn being completed successfully.

The pilot was keen to expedite the approach. Without waiting to see how *CMA CGM Centaurus* turned in the channel, he had committed to turning directly into the Terminal 1 basin when he confirmed his intention to *Emirates Dana*'s pilot at 1107. He reaffirmed his intention at 1122 when he increased the ship's engine speed to 'slow ahead'. At 1124, *Emirates Dana* was assisted away from Berth 19 by two tugs and then had to wait for *CMA CGM Centaurus* to clear the channel before being able to proceed outbound. The pressures on pilots to achieve fast turn-around times is further discussed at Section 2.8, but in his desire to clear the channel for the outbound vessel, the pilot risked making a faster approach to the turn into the Terminal 1 basin than was necessary.

2.2.3 Actions to control the ROT

Having ordered 'port 20º' and then 'hard to port' to start the turn, the pilot reduced the helm to 'port 20º' with the intention of limiting the ship's ROT. Following the master's remark to the effect that, in his view, the turn had been started too late, the pilot increased the helm to 'hard to port' and the engine speed to 'slow ahead'.

The pilot's actions to increase the helm and slightly increase the engine speed indicate that the master's comment had caused him some doubt. However, 2 minutes elapsed during which the ROT was not increasing as the pilot expected, before he took further action by increasing the engine speed to 'half ahead', confirming the helm was 'hard to port', ordering full bow thruster power to port, and instructing the tugs to assist. He then ordered 'full ahead'. Although the ship was turning to port at a rate of only 12º per minute, the pilot remained confident that a ROT of 20-25º could be achieved and that attaining such a rate would be sufficient to complete the turn successfully. A further 3 minutes elapsed before he realised that a collision with *NYK Crane* was imminent unless avoiding action was taken.

The pilot was faced with conflicting priorities. He needed to increase the ROT, and one method of achieving this was to temporarily increase engine speed. However, *CMA CGM Centaurus* was already travelling faster than he wanted, and he was almost certainly conscious that increasing the engine speed would make the subsequent task of stopping the ship even harder. He therefore delayed the application of engine power until it was too late to be effective. Had the pilot connected the tug assisting aft through the centreline fairlead, he could have used it to slow *CMA CGM Centaurus*, aid the turn, or a degree of both. However, the aft tug had not been connected and so was unable to assist.

2.2.4 Action to avoid the collision

The pilot's engine and helm orders ensured that *CMA CGM Centaurus* did not collide with *NYK Crane* but those same actions and, in particular the starboard helm orders given, made it inevitable that *CMA CGM Centaurus* would make contact with the quay. Although the pilot also ordered the port anchor to be let go, it is unlikely that such late action would have made a significant difference to the outcome and, by then, the foredeck crew had moved away to a position of safety.

When he realised that a collision was imminent and decided to take action, the pilot had few options available. The ship's speed would have rendered the bow thruster ineffective; the aft tug pushing on the ship's port quarter would have increased the ship's lateral movement towards *NYK Crane*; and hydrodynamic forces acting on the forward tug, which was secured to the ship's starboard shoulder but not able to push, would have created drag that reduced the ship's ability to turn to port.

The pilot had disposed the tugs to assist with turning *CMA CGM Centaurus* through 180º once it was off the berth, and when he needed their assistance quickly they were not in a position to react fast enough to be of use. Had he considered earlier the tugs' potential utility during the approach, he could have positioned them such that they could have assisted almost immediately to slow the ship's speed or assist with the turn.

2.3 THE SHIP'S BRIDGE TEAM'S ACTIONS

Neither *CMA CGM Centaurus*'s master nor the chief officer had previously visited Terminal 1, and the CMA Ships' port card for Jebel Ali did not provide details for manoeuvring prior to berthing at Terminal 1. After boarding, the pilot provided the master with information relating to the ship's berth, but he did not discuss how he intended to manoeuvre the ship into the basin prior to berthing.

The master did not ask the pilot when he boarded how he intended *CMA CGM Centaurus* would approach the berth, but during the inward passage he overheard the pilot first tell the trainee pilot that he would assess how the ship turned before deciding, and shortly afterwards tell *Emirates Dana*'s pilot that he would turn the ship directly into the basin. He made no attempt to query the pilot's intentions, and was unaware of how, where and at what speed the pilot intended to commence the turn. While he was content for the manoeuvre to proceed, he had nothing tangible on which to base his confidence in the pilot's competence or the effectiveness of his plan.

When the pilot gave the order to start the turn when *CMA CGM Centaurus* was still proceeding at 6.3kts the master did not challenge his decision. Further, as it became increasingly evident that the required ROT was not being achieved and that the pilot's actions to remedy the situation were ineffective, the master took no action to prompt the pilot to take more effective action, or to step in and take control himself.

The master and the chief officer had obtained their ship handling experience during the attainment of their CoCs. CMA Ships had supplemented this by providing them with additional simulator and manned model training, and both officers had witnessed and monitored numerous acts of pilotage. Despite their experience, neither officer felt able to determine with confidence that the ship was proceeding at too high a speed at the start of the turn to be able to complete the turn safely. Consequently, their actions to intervene were restricted to verbal comments that did not amount to effective challenges of the pilot's actions.

2.4 MASTER/PILOT RELATIONSHIP

SOLAS Regulation 34, as amplified by the guidance contained in IMO Resolution A.893(21), requires "*a comprehensive navigation plan for the safe conduct of the ship from berth to berth*". While masters have a duty to ensure a berth-to-berth passage plan is completed, frequently they are heavily reliant on the knowledge

provided by local marine pilots for the elements of the passage carried out in pilotage waters. However, as the list of previous accidents at Section 1.15 indicates, pilots are not infallible, and if reliance on the pilot is increased, the ability of the ship's team to intervene, should it become necessary, is weakened. In recognition that safety requires close cooperation between ships' masters/bridge teams and pilots, the relevant maritime organisations have provided the following guidance to promote the importance of them working closely together:

- Guidance on the respective roles, responsibilities and authority of pilots and masters/bridge teams (see Section 1.8).

- Guidance on the contents and conduct of the MPX (see Section 1.10). And

- Guidance on the conduct of training in BRM and BRM-P (see Section 1.13).

Weaknesses in all three areas were evidence during this accident, and these are further discussed below.

2.5 ROLES AND RESPONSIBILITIES

2.5.1 Guidance

IMO Resolution A.960 Annex 2, article 2.1 makes clear that the presence of a pilot does not relieve the ship's bridge team from their duties and obligations for the safety of the ship, and promotes a need for the pilot and bridge team to understand each other's roles. Without stating what those roles should be, it specifies that the master and bridge officers have a duty to support the pilot, and to ensure that the pilot's actions are monitored at all times.

The ICS BPG goes further by referring to the master as having ultimate responsibility for the safety of the ship. It also refers to the ship's bridge team maintaining responsibility for the safe navigation of the ship, and provides guidance as to how this is to be achieved. Specifically, it refers to pilots being supported by the ship's bridge team by operating navigation equipment, providing advice, monitoring the pilot's actions, monitoring the ship's progress against the pilotage plan, identifying misunderstandings and seeking clarifications if in any doubt.

On 4 May 2017, as *CMA CGM Centaurus* was approaching Jebel Ali, both the pilot and the ship's master were content for the approach and berthing to be conducted with the pilot conning the ship with no input or support from the bridge team. Consequently, there was no agreed plan and no shared understanding for the intended manoeuvre into the Terminal 1 basin, the use of tugs, de-confliction from other shipping movements, and what contingency measures were available should the plan need to change. The result was that the pilot's decision-making became a single system point of failure with respect to safe navigation.

Both the pilot and the master could have ensured that an appropriate exchange of information took place before *CMA CGM Centaurus* reached the turn into the Terminal 1 basin, but neither did. It can therefore be concluded that both individuals placed little value on the support that could be provided to the pilot by the bridge team during the ship's approach to Jebel Ali.

2.5.2 The pilot

The pilot boarded *CMA CGM Centaurus* as the ship was entering the approach channel and therefore did not have the luxury of discussing his plan in detail with the master before commencing the pilotage. However, by ordering 'full ahead' immediately he arrived on the bridge, the pilot was taking the con and making it clear that he considered himself to be in sole charge of events. During the following 50 minutes before commencing the turn into the Terminal 1 basin, he did little to brief or engage the master or bridge team. As discussed below, the initial MPX did not contain the detail necessary for the bridge team to understand the pilot's plan, and he did not invite them to contribute towards the safe execution of the pilotage. When he did verbalise his intentions, it was to his colleagues – the trainee pilot and the pilot on *Emirates Dana* – leaving the bridge team to discern his plan by overhearing his conversations.

By not actively engaging with the bridge team, the pilot effectively signalled he did not need their assistance, so it is unsurprising that they were not forthcoming with challenges or advice at critical times during the approach.

2.5.3 The master

As highlighted in section 3.2 of the International Best Practices for Maritime Pilotage (discussed in section 2.6.2), the master should agree the overall plan before the ship is committed to the approach. In agreeing to Jebel Ali Port Control's advice to continue towards the entrance of the buoyed channel before embarking the pilot, *CMA CGM Centaurus*'s master denied himself the opportunity to complete a detailed MPX and agree the pilotage plan before committing the ship to the channel.

The port's instruction is discussed separately in Section 2.7.1. However, the master was under no time pressure to enter the port. The master could have adopted a firmer approach by declining to take *CMA CGM Centaurus* into the channel until the pilot had embarked and, once he was on board, not allowing the pilot to take the con until the MPX was completed. In such circumstances, it is possible that a more complete MPX would have taken place such that this accident would have been avoided. Even though the master had agreed to take his ship into the approach channel before the pilot boarded, there was still ample time for an effective MPX before the turn into the Terminal 1 basin.

CMA CGM Centaurus's bridge had the manoeuvring data for turning the ship in the loaded condition in shallow water at a 'half ahead' speed of 12.2kts. While this data complied with IMO Resolution A.601(15), the information did not help the ship's team with either planning or assessing the turn into the Terminal 1 basin. Consequently, the master had no reference material against which to validate his concerns about the ship's speed at the start of the turn or the subsequent ROT.

Ports will usually want to accept the largest vessels possible, with the result that minimum UKCs have to be stipulated and fine judgements made as to whether or not any particular ship can successfully negotiate a turn without tug assistance. The required minimum manoeuvring data stipulated in IMO Resolution A.601(15) is of little value in such circumstances, and vessel operators should consider providing their vessels with enhanced data for manoeuvring in the confines of the port environment.

CMA CGM Centaurus's master and chief officer had both attended manned ship model and simulator training specifically tailored for very large container ships. However, they had not put this training into practice as manoeuvring their ship in confined waters, and berthing and un-berthing manoeuvres were normally conducted by the pilot.

While masters of large container ships may lack the experience and proficiency to confidently manoeuvre their ships in port, they nonetheless retain the duty to ensure their vessel is navigated safely. This is best achieved through early discussions during the MPX so they understand the pilot's intentions, can assess the feasibility of the intended plan, and have explored what contingency measures are available if, as in this instance for example, the required ROT is not being achieved. Further, by questioning so as to understand the pilot's intentions, the master is emphasising that he retains the overarching responsibility for the ship's safety.

2.6 THE MASTER/PILOT INFORMATION EXCHANGE (MPX)

2.6.1 Conduct of the MPX

The MPX carried out on *CMA CGM Centaurus* on 4 May 2017 lacked structure and detail. There was no formal exchange of information except for confirmation of the berth, ropes required and number of tugs to be used. The pilot did not explain the detail of the passage plan, how he intended to conduct it, or the speed profile. For his part, the master did not ask for any of this detail, nor did he brief the pilot on the vessel's propulsion, steering and manoeuvring characteristics. There was little further discussion as the approach proceeded. Consequently, the ship's bridge team were unable to monitor progress against the pilot's intended plan and were always reacting to events, instead of being able to anticipate difficulties and take action to assist or intervene.

2.6.2 Berth-to-berth passage planning

Ships' masters need to be familiar with the port they are approaching so they can assess the feasibility of the pilot's proposed plan. However, *CMA CGM Centaurus*'s master placed little value on the SMS requirement to complete a berth-to-berth passage plan as, in his experience, a pilot normally provided a passage plan and it was that plan that was used for the pilotage. As a consequence, the ship's team had not completed a plan for the approach into Jebel Ali, and the planned track ended in the approach channel.

The ICS BPG acknowledges that it might not be practicable to include all the details relating to arrival at the planning stage, and therefore the pilotage plan might not be completed until after the MPX. However, after the pilot had boarded *CMA CGM Centaurus*, no attempt was made by the ship's bridge team to complete the passage plan to the berth. For his part, the pilot made no attempt to share his passage plan with the master, and saw little requirement to do so. The little briefing of intentions that he did carry out was directed to the trainee pilot and the pilot on *Emirates Dana*, but not the bridge team on *CMA CGM Centaurus*.

Section 3.2 of International Best Practices for Maritime Pilotage[22] states:

> *'After taking this information into account and comparing the pilot's suggested plan with that initially developed on board, the pilot and master should agree an overall final plan early in the passage before the ship is committed. The master should not commit his ship to the passage until satisfied with the plan. All members of the bridge team should be made aware of the plan such that the whole bridge team have a shared understanding of the passage plan.'*

Whether the final element of a berth-to-berth plan is prepared on board, or is derived from a port passage plan supplied before arrival, it is crucial that ships' bridge teams review the plan so as to properly understand the hazards and constraints associated with the port in question. Only then can they assess the feasibility of the pilot's intended plan using their knowledge of their ship's specific manoeuvring characteristics. For their part, while pilots might have a great deal of experience of their port and possibly of similar vessels, they are unlikely to have a detailed knowledge of any particular vessel's manoeuvring characteristics or other issues that might impact on their ability to complete the act of pilotage successfully. The ship's bridge team can provide this information, which can be crucial to the success of the plan, and by thoroughly briefing the bridge team and agreeing the passage plan, the pilot will engage them to monitor his actions effectively.

Whatever the circumstances of the pilotage, there would be benefits from pilotage authorities sending vessels details of the intended port entry passage plan ahead of their arrival. This would give bridge teams time to familiarise themselves with those intentions so that only any adjustments to the plan need to be discussed during the MPX.

2.6.3 Company oversight

International guidance on the preparation of passage plans and the conduct of the MPX had been clearly reiterated and specified in CMA Ships' procedures (Sections 1.9.2 and 1.10.2). However, neither activity was being carried out on board *CMA CGM Centaurus* to the extent required by the company.

Evidence obtained by the MAIB in the course of this investigation suggests that it is extremely rare for pilots boarding large container ships to be presented with a pilotage plan prepared by the ship's bridge team. It also suggests that while pilots generally agree with the principle of an MPX, its execution varies widely between shipping companies and pilotage authorities.

There is a need for CMA Ships to review its internal monitoring and auditing processes to ensure it can detect deviations from its policies and procedures. However, it also needs to adopt measures designed to reinforce to masters the value of both the berth-to-berth passage plan and effective MPX, to equip them with the knowledge and guidance needed to assess the feasibility of pilots' passage plans, and to empower them to resist pressures to commence port approaches before the necessary preparations are complete.

[22] An ICS, Intertanko and OCIMF publication. See Section 1.10.1

2.7 PORT RESPONSIBILITIES

2.7.1 Pilot boarding area

CMA CGM Centaurus was at the pilot station at 1024, but directed by Jebel Ali Port Control to proceed directly to the entrance to the channel where the pilot boarded at 1031. As a result, there was no opportunity for the pilot to become familiar with the bridge layout or to complete the MPX before commencement of the approach.

Pilot boarding areas need to be located, and pilots should board to allow sufficient time for a suitable MPX to be completed before the act of pilotage commences and the vessel enters areas of confined navigation. In this instance, the pilot boarding area was a short distance outside the approach channel, and so the pilot could have boarded and time been made to prepare for the pilotage by *CMA CGM Centaurus* either slow steaming or drifting. By directing *CMA CGM Centaurus* into the approach channel before the pilot had embarked, Jebel Ali Port Control removed the opportunity for essential pre-pilotage safety procedures to be completed.

2.7.2 Tug employment

Jebel Ali port regulations stipulated that tugs must be available before a ship passes inside the inner breakwater. In this case the tugs attending *CMA CGM Centaurus* attended later, and then were attached to assist with turning the ship off the berth. As a consequence, the tugs were not able to act to slow the ship nor to assist it when it became necessary to increase the ROT during the turn into the Terminal 1 basin.

A more effective use of the tugs available in this case would have been to make a tug fast on the centre lead aft, able to act to slow or help turn the ship, and the second tug fast on the centre lead forward, both to be connected before the turn into the basin commenced. The stern tug could have been made fast first, with the bow tug standing by until the ship's speed had reduced to a suitable speed for it to approach the bow. Such a configuration would also have acted as a reminder to the pilot and bridge team to slow the ship's speed in good time.

The employment of tugs to assist during a ship's approach or with its berthing manoeuvre will always be a matter for the pilot and master to agree and will depend upon the conditions and circumstances prevailing at the time. Nonetheless, the port authority can play a useful role by ensuring that best/expected practice with respect to tug employment is included in its port entry instructions, and that its pilots and tug operators are aware of the port authority's expectations.

2.7.3 Competent pilots

As identified in Section 2.6.2, *CMA CGM Centaurus*'s pilot did not brief the ship's team on his intentions, and did not enable their input into the pilotage by engaging effectively with them. Whether this was indicative of his normal manner or because his behaviour was affected by and became a product of his work environment is less clear: in either case it was not conducive to a safe and effective act of pilotage.

When a port makes pilotage compulsory it has a responsibility to ensure the pilotage service provided is of an appropriate standard. Specifically, port authorities must ensure that the pilots they provide are qualified, trained and competent in their role.

DP World recruited qualified master mariners with a minimum of 5 years previous experience as its pilots, and expected that they would be conducting pilotage on ships of up to 200m length after 1 month of familiarisation training. Newly recruited pilots were not provided with BRM training as it was assumed that they had undertaken this either in the course of obtaining their qualifications or during previous employment.

The IMO acknowledges that specific BRM training is necessary for pilots (see Section 1.13.2) and its Resolution A.960, Annex 1 Section 5.3 states, inter alia, that '*Every pilot should be trained in bridge resource management with an emphasis on the exchange of information that is essential to a safe transit*.' The annex goes on to say that '*Competent pilotage authorities should be encouraged to provide updating and refresher training conducted for certified or licensed pilots to ensure the continuation of their proficiency and updating of their knowledge…*'. By not requiring its newly recruited pilots to undertake BRM-P training, Jebel Ali port authority missed the opportunity to both emphasise its commitment to the effective integration of its pilots with bridge teams, and ensure its pilots were trained/refreshed in the principles of effective BRM.

2.8 MEASURING KEY PERFORMANCE INDICATORS

Many of the factors contributing to this accident can be attributed to a focus on completing acts of pilotage as quickly as possible. These include:

- Port Control directed *CMA CGM Centaurus* to enter the approach channel before the pilots had embarked, leaving limited opportunity for an effective MPX.
- The pilot's first action on boarding was to order 'full ahead'.
- *CMA CGM Centaurus* was travelling too fast to make the turn into the Terminal 1 basin without tug assistance.
- The tugs joined the inbound ship late in the channel, and were then attached to facilitate the turn off the berth without the need to re-position.
- The pilot made a premature decision to turn *CMA CGM Centaurus* directly into the Terminal 1 basin before he had ascertained whether the ship turned well.
- *Emirates Dana*'s pilot unberthed his vessel before *CMA CGM Centaurus* had cleared the channel, thereby denying the pilot on the inbound vessel the opportunity to change his mind about his choice of approach.

Ports and terminals need to monitor their performance and adopt measures to improve their efficiency if they are to remain competitive. However, monitoring the time taken to conduct safety critical acts such as the pilotage, and linking the attainment of time targets with bonus payments can lead individuals into prioritising performance and reward over safety. While none of those interviewed during the investigation felt that time pressures affected their decision-making, their actions tell a different story. The priorities set at senior management level have a significant

impact on the safety culture of a port and there is a need to recognise that time-pressure, in the quest for terminal efficiency or financial reward, can have a negative effect.

2.9 SIMILAR ACCIDENTS

This investigation has focused on the specific requirements of very large container vessels.

The size of container vessels has grown at a rapid pace, yet ports remain largely the same. The margins for error are therefore decreasing. There have been a number of high profile groundings of large container vessels in the past 2 years (Section 1.15.2).

Despite extensive industry guidance and the numerous recommendations following previous MAIB investigations, and those of other established accident investigation bodies, many masters still find it difficult to actively engage in the act of pilotage. Moreover, many pilots appear content to keep the interaction between themselves and the bridge team to a minimum. Masters and pilots are mostly intelligent, conscientious individuals, so why this cultural divide continues to persist at all is particularly exasperating given the obvious potential consequences of an accident involving such vessels as *CMA CGM Centaurus* in the environs of a commercial port and the clear recognition on both sides of the divide that a problem exists. More effort clearly needs to be made to break down the cultural divide to ensure that mutual cooperation and respect between the bridge team and pilot becomes the norm. A requirement for port operators to insist that pilots attend the BRM-P course and actively apply its principles during all acts of pilotage, would help in this respect.

SECTION 3 - CONCLUSIONS

The conclusions are divided into two sections as shown below:

3.1 SAFETY ISSUES DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. The pilot decided to assess for himself how *CMA CGM Centaurus* turned before deciding how to manoeuvre it into the Terminal 1 basin, but then chose to attempt the turn before he had made that assessment. [2.2.1]

2. In his desire to make haste, the pilot risked making a faster approach to the turn into the Terminal 1 basin than was necessary. He did not appreciate that the additional speed would prevent the turn being completed successfully. [2.2.2]

3. The pilot had deployed the tugs in order to assist with turning *CMA CGM Centaurus* through 180º once it was off the berth. When the tugs were needed to help increase the vessel's rate of turn they were not in a position to react fast enough to be of use. [2.2.4]

4. Despite their experience, neither the master nor the chief officer felt able to determine with confidence that the ship was proceeding at too high a speed at the start of the turn to enter the basin safely. [2.3]

5. Both the pilot and the master could have ensured that an appropriate exchange of information took place before *CMA CGM Centaurus* reached the turn into the Terminal 1 basin, but neither did. It can therefore be concluded that both individuals placed little value on the support that could be provided to the pilot by the bridge team during the ship's approach to Jebel Ali. [2.5.1]

6. By not actively engaging with the bridge team, the pilot effectively signalled he did not need their assistance, so it is unsurprising that they were not forthcoming with challenges or advice at critical times during the pilotage. [2.5.2]

7. Despite increasing evidence that the required ROT was not being achieved and that *CMA CGM Centaurus* would not complete the turn into the Terminal 1 basin safely, the master did not intervene and take steps to remedy the situation. [2.3, 2.5.3]

8. *CMA CGM Centaurus*'s master and chief officer had both attended manned ship model and simulator training specifically tailored for very large container ships. However, they had not put this training into practice as manoeuvring their ship in confined water, and berthing and un-berthing manoeuvres were normally conducted by the pilot. [2.5.3]

9. The required minimum manoeuvring data stipulated in IMO Resolution A.601(15) is of little value when planning manoeuvres in the confines of the port environment, and ship operators should consider providing their ships' teams with enhanced data for such circumstances. [2.5.3]

10. The initial MPX carried out on *CMA CGM Centaurus* on 4 May lacked structure and detail. There was little further discussion as the approach proceeded. Consequently, the ship's bridge team were unable to monitor progress against the pilot's intended plan and were always reacting to events, instead of being able to anticipate difficulties and take action to assist or intervene. [2.6.1]

11. By directing *CMA CGM Centaurus* into the approach channel before the pilot had embarked, Jebel Ali Port Control removed the opportunity for essential pre-pilotage safety procedures to be completed. [2.7.1]

12. The tugs were not able to act to slow the ship nor assist when it became necessary to increase the ROT during the turn into the Terminal 1 basin. [2.7.2]

13. Port authorities can play a useful role by ensuring that best/expected practice with respect to tug employment is included in its port entry instructions, and that pilots and tug operators are aware of the port authority's expectations. [2.7.2]

14. By not requiring its newly recruited pilots to undertake BRM-P training, Jebel Ali port authority missed the opportunity to both emphasise its commitment to the effective integration of its pilots with bridge teams, and ensure its pilots were trained/ refreshed in the principles of BRM. [2.7.3]

15. Many of the factors contributing to this accident can be attributed to a focus on completing acts of pilotage as quickly as possible. The priorities set at senior management level have a significant impact on the safety culture of a port, and there is a need to recognise that time-pressure, in the quest for terminal efficiency or financial reward, can have a negative effect. [2.8]

16. Despite extensive industry guidance, there continues to be a reluctance by masters and pilots to work together in accordance with the principles of BRM during the acts of pilotage not involving themselves in the pilotage of their vessels. [2.9]

3.2 SAFETY ISSUES NOT DIRECTLY CONTRIBUTING TO THE ACCIDENT THAT HAVE BEEN ADDRESSED OR RESULTED IN RECOMMENDATIONS

1. *CMA CGM Centaurus*'s master placed little value on the requirement to prepare a berth-to-berth passage plan, as it was his experience that the pilot usually provided the plan and it was the pilot's plan that was used. Consequently, the ship's plan ended in the approach channel and no plan had been prepared for the approach to Jebel Ali. For his part, the pilot made no attempt to share his plan, and saw no requirement to do so. [2.6.2]

2. Whatever the circumstances of the pilotage, there would be benefits from pilotage authorities sending vessels details of the intended port entry passage plan ahead of their arrival. This would give bridge teams time to familiarise themselves with those intentions so that only any adjustments to the plan need to be discussed during the MPX. [2.6.2]

SECTION 4 - ACTION TAKEN

4.1 MAIB ACTIONS

Following the grounding of *CMA CGM Vasco de Gama* on 22 August 2016, the MAIB recommended CMA Ships to:

- Conduct a thorough review, through its internal audit process, of the implementation of company procedures for pilotage planning, use of ECDIS and BRM, and take steps to improve onboard standards and levels of compliance.

- Include standards of pilotage and bridge team/pilot integration as specific items for assessment and comment in its internal navigation audit reports.

CMA Ships has planned appropriate action in response to the first recommendation, and the second recommendation has been implemented.

4.2 ACTIONS TAKEN BY OTHER ORGANISATIONS

4.2.1 CMA Ships

Following the grounding of *CMA CGM Vasco de Gama* on 22 August 2016, CMA Ships has:

- Implemented mandatory computer-based BRM training for all bridge officers at the start of each vessel contract.

- Implemented 'Port Approach Training' for its masters and chief officers, including invited pilots from around the world.

Following this accident involving *CMA CGM Centaurus* on 4 May 2017, CMA Ships has:

- Issued a safety alert to its fleet, referring to its pilotage management SMS requirements.

- Carried out a full internal accident investigation to ascertain the causes of the accident for the purposes of preventing future accidents.

- Issued the following additional guidance to the fleet following its investigation:

  - *'During meeting with pilot, make clear in advance all details of the coming manoeuvring till the berth – when and how tugs fast, max approach speed, manoeuvring options, traffic, ensure pilot is aware of your vessels manoeuvring characteristics.*

  - *Always consider to make a tug fast by centre lead aft during approach in case of emergency.*

  - *Never rely only on pilot appreciation for manoeuvring.*

- *Once pilot decision looks unsafe to you, challenge and be ready to take over command.*

- *All bridge team should inform and alert other bridge personnel of any deviance from the initial meeting with pilot.*' [sic]

- Carried out a review of relevant sections of the SMS.

- Amended the internal audit procedure to include the MPX.

- Planned to roll out a new programme of onboard mentors in 2018 to carry out navigation training, including passage planning and attitude with a pilot on board.

- Modified the CMA CGM port card for Jebel Ali to take into account the findings of its investigation.

- Formed a working group within the Container Ship Safety Forum to look at a co-operative approach for the container industry and pilot/port associations.

- Provided all ships with a maximum approach speed guideline table to supplement the information on the wheelhouse poster.

4.2.2 DP World UAE Region

Actions intended or already taken by DP World UAE Region include:

- Issued an instruction prohibiting the turning of ships over 300m LOA within the terminal basin.

- Issued an instruction restricting the speed of ships to 5kts when approaching the first basin.

- Strict enforcement of its gantry crane positioning policy.

- Confirmed the role of Vessel Traffic Management with regard to the management and monitoring of shipping inside the port and its approaches.

- Made use of the simulator at the Marine Department to enhance current training provided to pilots, with particular reference to emergency scenarios that could be encountered, and the precautionary measures that are required to be observed and adhered to with regard to such emergencies.

- Engaged a third party to provide training to pilots aimed at preventing similar accidents and at helping to reduce mental stress and to avoiding fatigue.

4.2.3 International Maritime Pilots' Association

The International Maritime Pilots' Association has published Recommendations on Bridge Resource Management Courses for Maritime Pilots (BRM-P), which is reproduced at **Annex H**.

SECTION 5 - RECOMMENDATIONS

DP World UAE Region is recommended to:

2018/127 Review and improve its management of pilotage and berthing operations in respect of large container ship movements within the port of Jebel Ali, with particular regard to the following:

- Development of approved pilotage and manoeuvring plans, including optimum use of tugs and ensuring ships do not commit to the buoyed channel until completion of a detailed and effective master/pilot information exchange.
- Provision of approved pilotage and manoeuvring plans to a visiting ship as soon as practicable prior to the pilot boarding.
- Provision of Bridge Resource Management training specifically tailored to meet the needs of pilots.
- Removal of Key Performance Indicators that potentially create inappropriate performance bias towards efficiency against safety.

The **International Chamber of Shipping**, the **International Maritime Pilots' Association** and the **International Harbour Masters' Association** are recommended to:

2018/128 Conduct a joint campaign of information for ships' bridge teams, pilots and port authorities designed to:

- Promote the benefits of adhering to effective bridge resource management procedures during acts of pilotage.
- Endorse the BRM-P course as an effective means of providing pilots with the necessary skills to best utilise the resources available during acts of pilotage.

Safety recommendations shall in no case create a presumption of blame or liability

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