



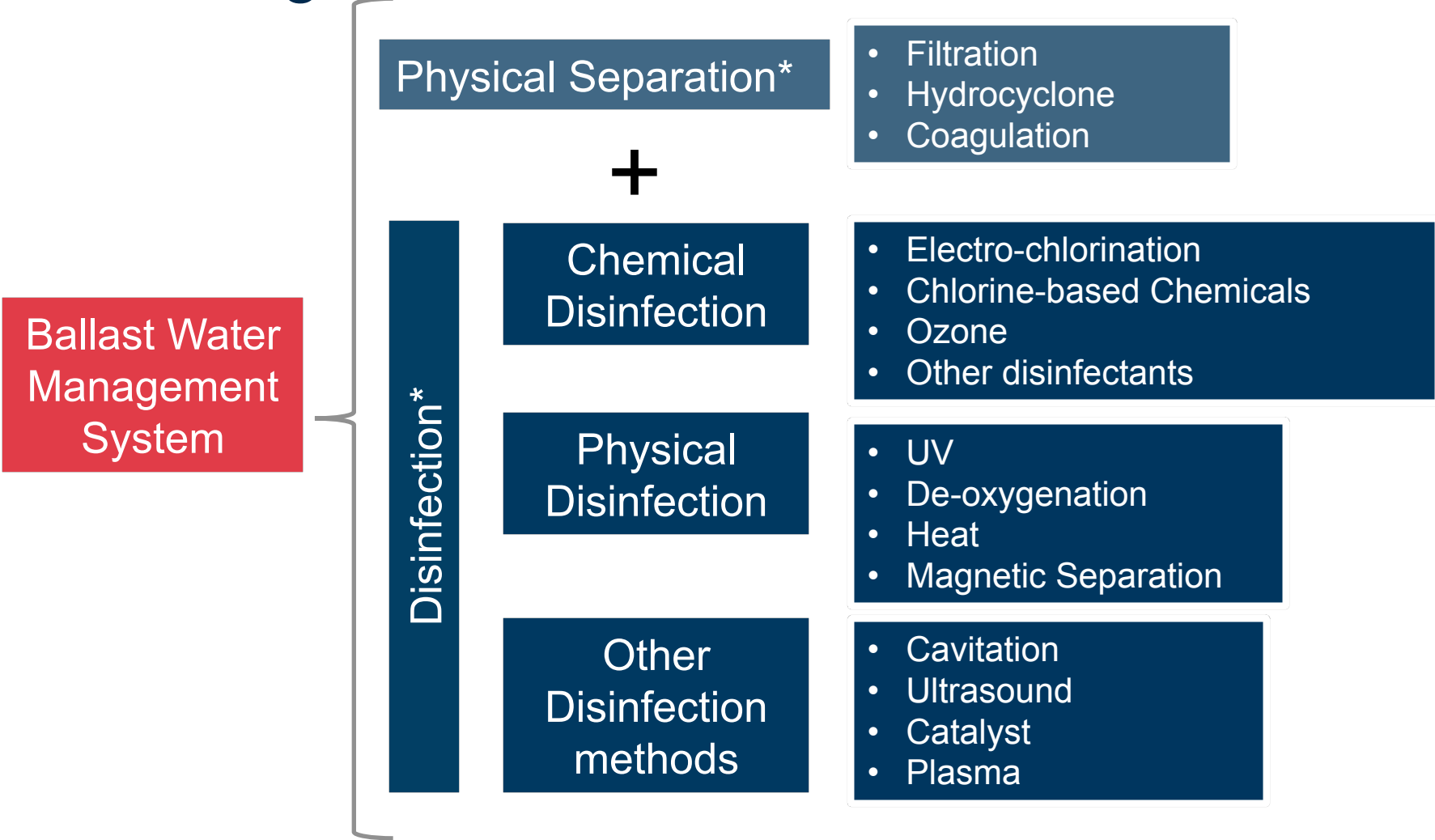
BWTS technologies, and update - Are BWTS systems performing?

Antony Vourdachas | November 2017
Greener Shipping | Athens



© 2017 American Bureau of Shipping. All rights reserved

BWMS Technologies

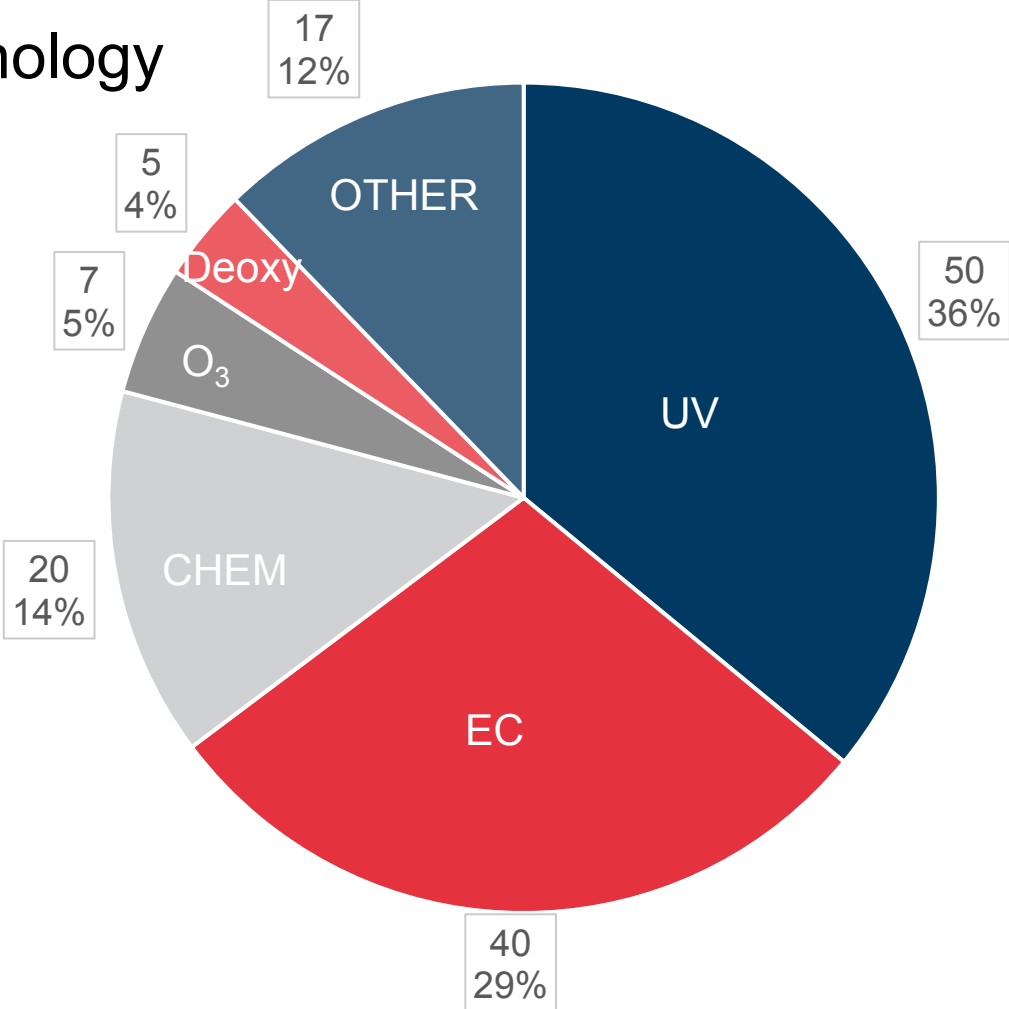


*Note: BWMS have been developed using different combinations of the technologies



BWMS – Available or In Development by Technologies

- Most BWMS use filtration and another technology
- Some BWMS use combinations of technologies – those are counted multiple times



BWMS – Approvals

Market Entry	G9 Basic	G9 Final	2005 G8	2008 G8	2016 G8	USCG AMS	USCG LOI	USCG Application	USCG Approved
133	58	42	5	68	0	58	49	3 + 7	6

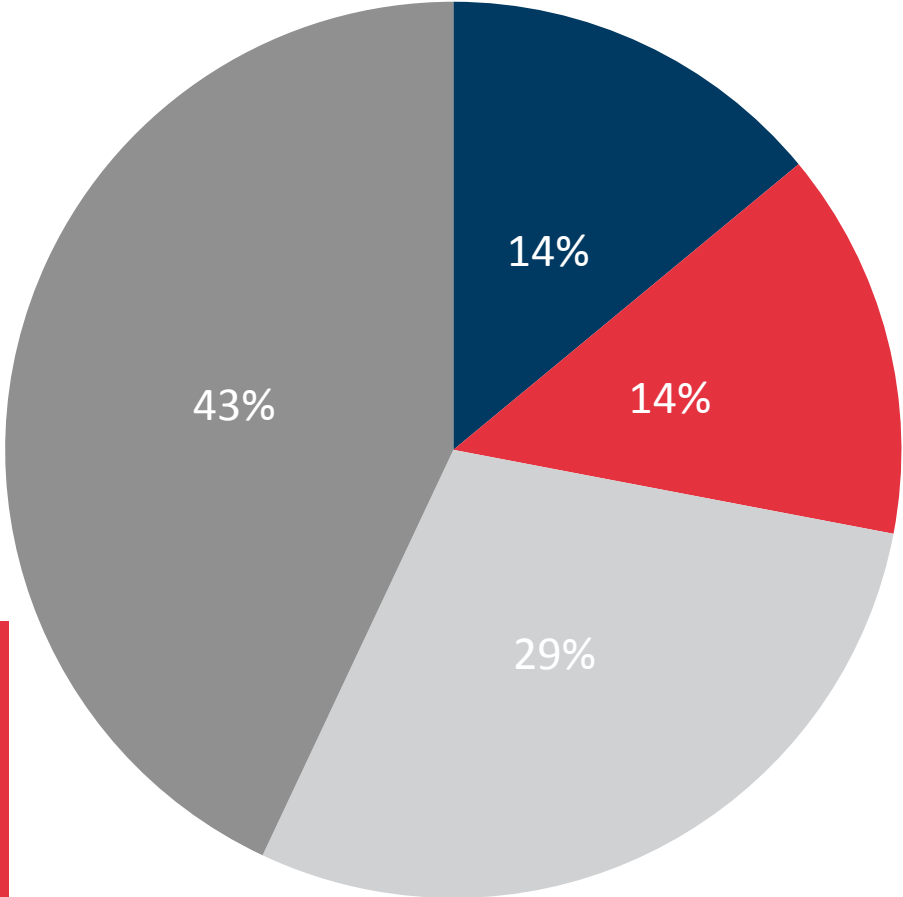
- Tracking ~ 133 BWMS that have some level of market entry with and without any approvals
- Some UV-based BWMS have G9 basic and final
- Few IMO type approved under Resolution MEPC.125(53) 2005 G8
- Most IMO type approvals under Resolution MEPC.174(58) 2008 G8
- All USCG AMS are IMO type approved – but not all IMO type approved are AMS
- Not all AMS have USCG LOI – not all LOI's are IMO type approved
- USCG applications cited include 3 UV-based applications based on MPN, 6 applications resulting in approvals, and 2 applications in review

Workshop Background

- ABS/MARTECMA sent out a questionnaire inquiring about shipowners challenges and lessons learned regarding BWTS
- Questionnaire Responses
 - 27 Shipowners
 - 220 vessels (bulk carriers, tankers, container ships, LNG carriers, and gas carriers)
 - 8 types of Ballast Water Treatment Systems
- ABS led an open discussion with the shipowners using this aggregated data from the responses

Sample System Data

BWMS Operability



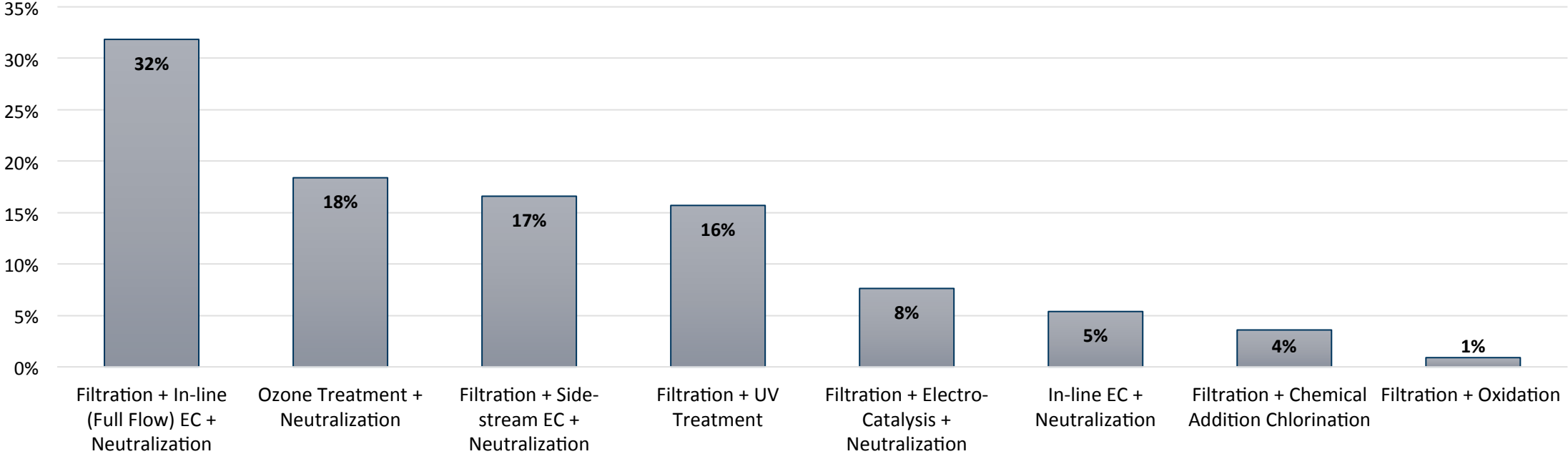
- Regularly Operated, subject to monitoring/efficacy testing
- Inoperable
- Operations are Problematic
- Regularly Operated, not subject to monitoring/efficacy testing

Survey results included responses from 27 owners representing 220 installations



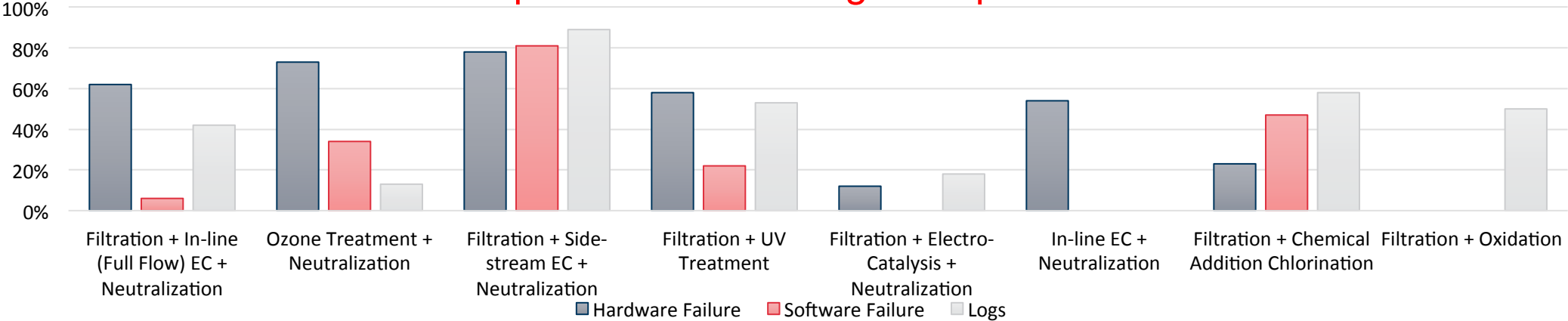
BWMS Operational Experience Questionnaire Results

Technology Types

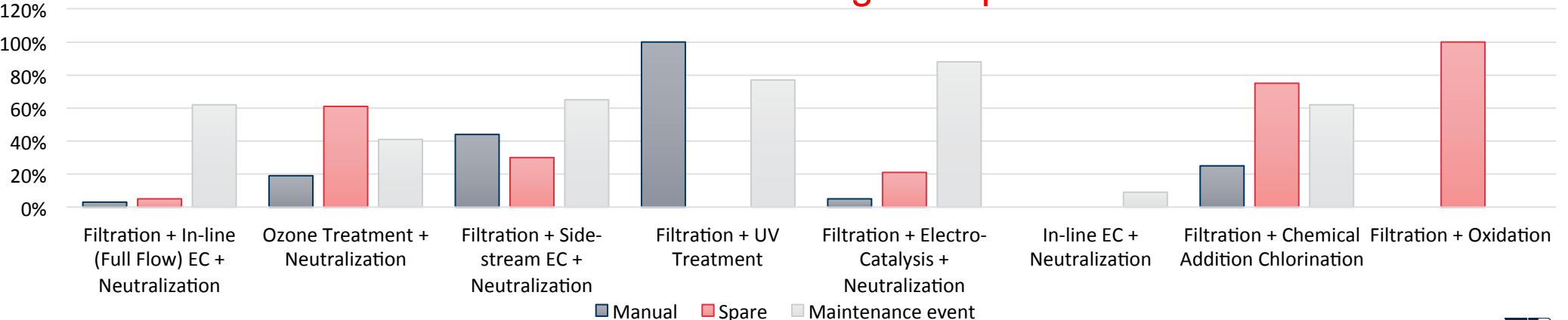


BWMS Operational Experience Questionnaire Results

Operational Challenges Reported

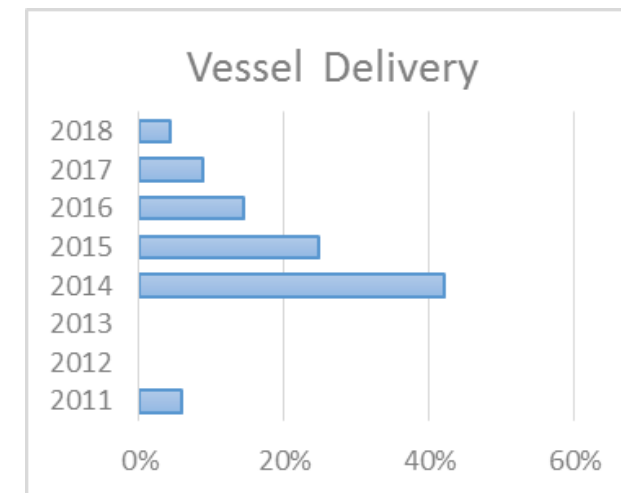
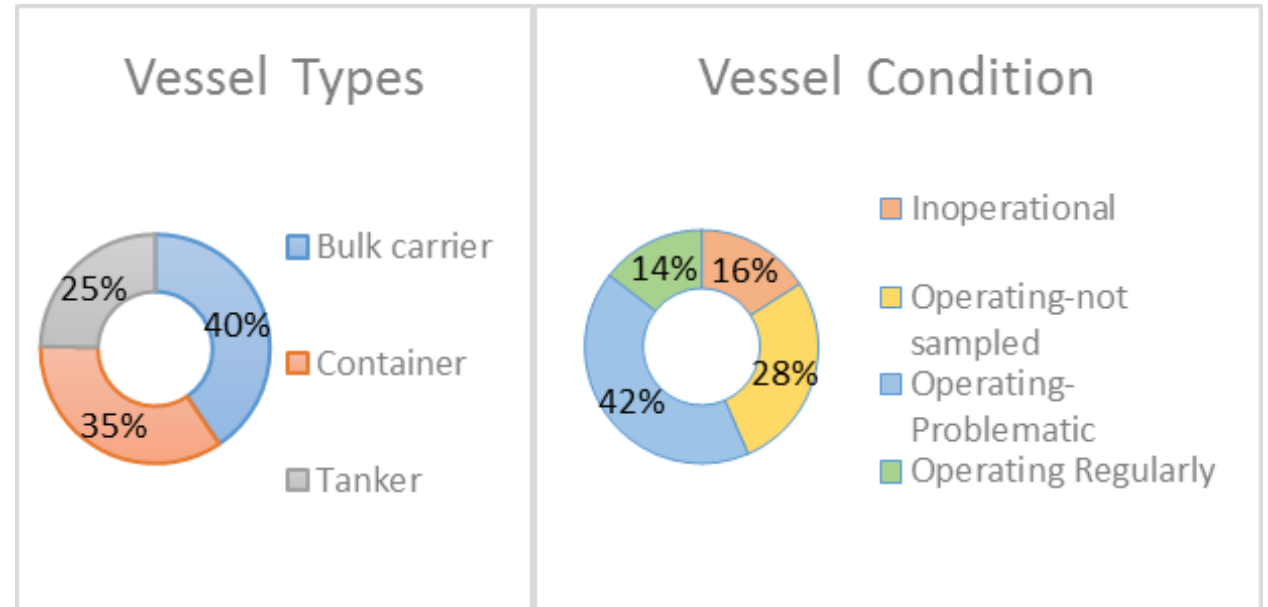


Maintenance Challenges Reported



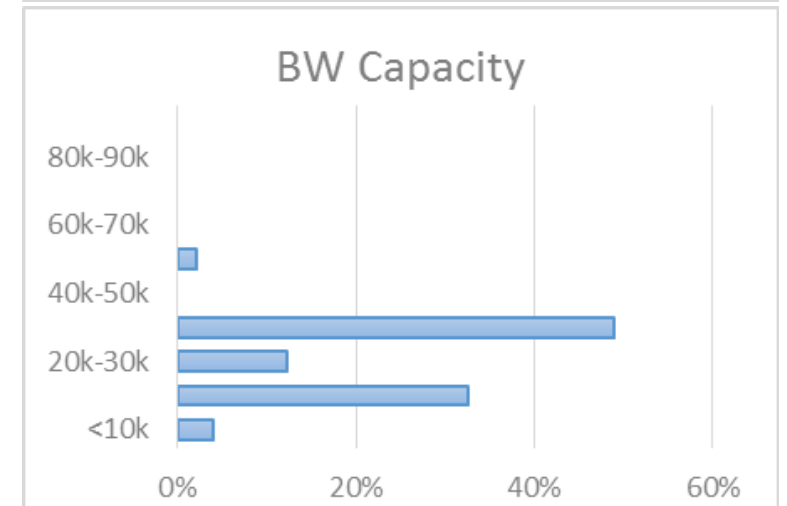
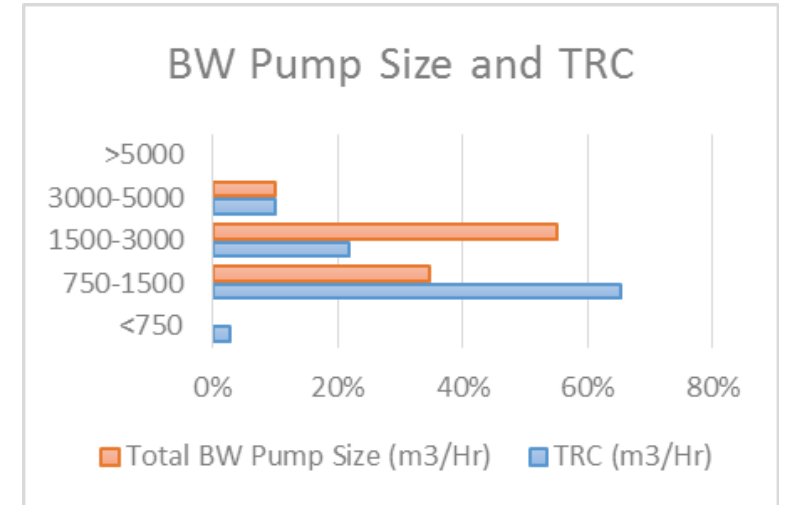
Filtration + In-line (Full Flow) EC + Neutralization – 32%

- Hardware Failure (62% reported)
 - TRO sensor/TRO concentration low
 - Filters clog in certain ports/ivers
- Software Failure (6% reported)
 - Valve order out of sync/rectifier communication
- Human error (6% reported)
 - System is very complicated
 - Equipment installed in separate locations
- Health and Safety Issues (4% reported)
 - Chemicals used during operations
- Reduction in Ballast rate (43% reported)
- Other issues/Challenges (42% reported)
 - Do not notify when working out of parameters
 - TRO reagent shelf life
 - TRO dosage either low/too low or high/too high for de-ballasting



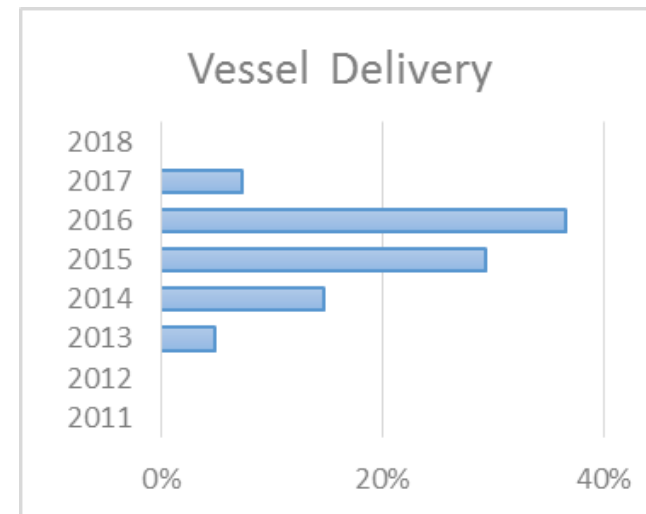
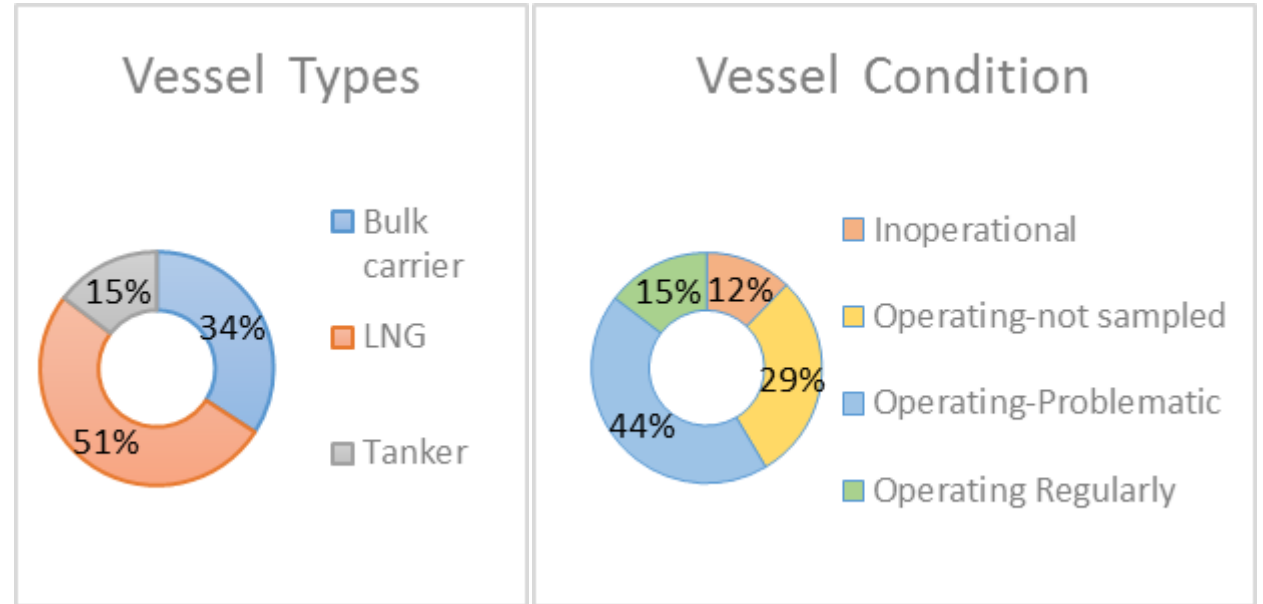
Filtration + In-line (Full Flow) EC + Neutralization – 32%

- Systems logs regularly monitored (75% reported)
 - (25%) Satisfied with regular system logs
- OMM Completeness (87% reported)
 - (97%) Satisfied with manual
- After sales Service (78% reported)
 - (94%) Satisfied with spare parts
- Maintenance event, issues/challenges (62% reported)
 - Several errors of installation and service requirements with spare parts
 - 6-7 claims per vessel
 - Sensors, transmitters, indicators, etc. are very sensitive
- Consumable Replenishment, issues, and challenges (23% reported)
 - Chemical supplies are required as a consumable
 - Required chemicals are not easily permitted in some ports
 - Neutralization chemical solidified due to humidity



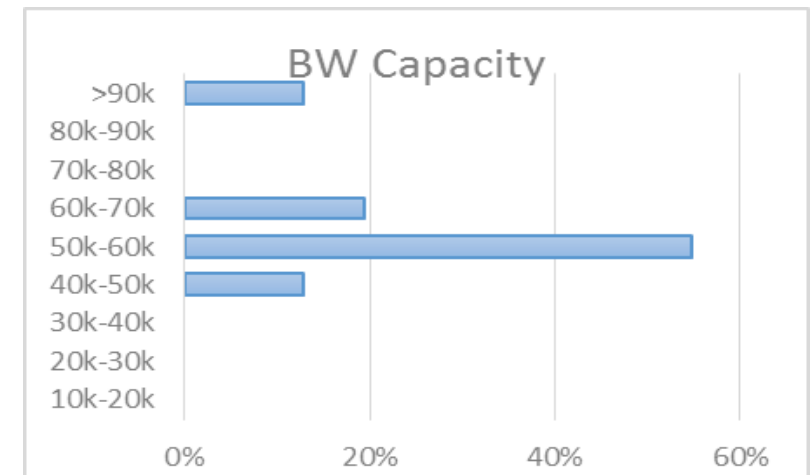
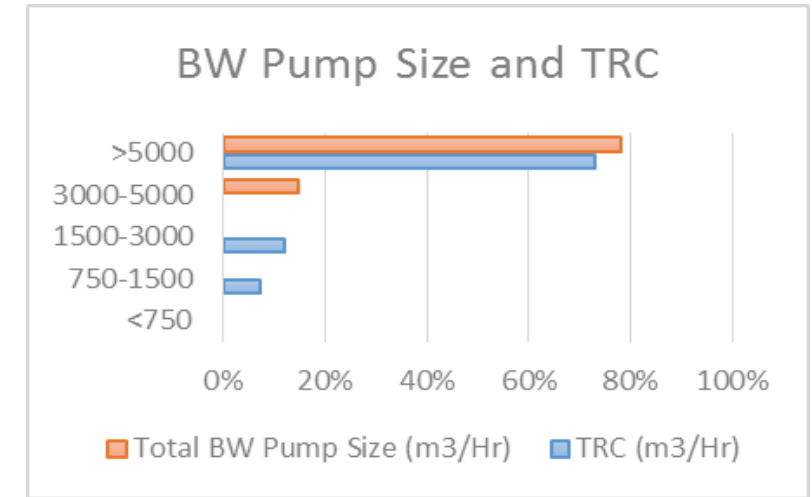
Ozone Treatment + Neutralization – 18%

- Hardware Failure (73% reported)
 - Oxygen sensor/analyzer
 - Ozone sensor
 - Water chiller malfunction
- Software Failure (34% reported)
 - Low ozone output
 - System data can't be saved
 - Inaccurate output of log files
 - Injection pump has no signal
 - PLC failure, O3 production fail in auto mode
- Impact on coating/piping (7% reported)
 - O3 injection pipe holed
 - Neutralizer solution pipes in P/R void were replaced due to plenty of pin hole



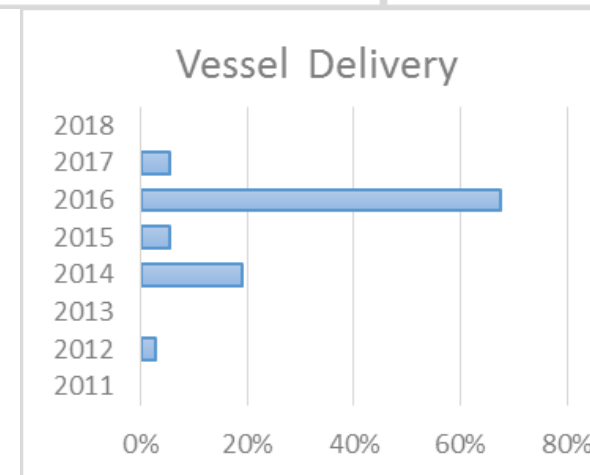
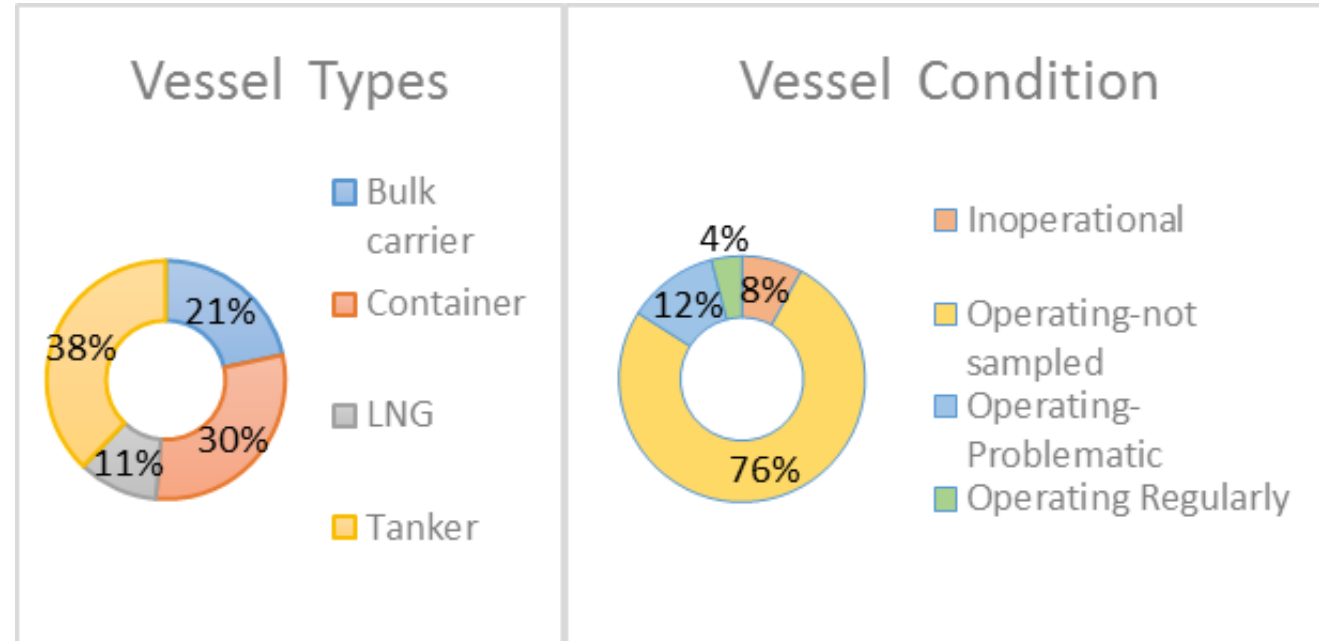
Ozone Treatment + Neutralization – 18%

- Systems logs regularly monitored (78% reported)
 - (87%) Satisfied with system logs
- OMM Completeness (92% reported)
 - (79%) Satisfied with the Manual
- After sales Service (78% reported)
 - (22%) Satisfied with the after sale service
- Maintenance event, issues and challenges (41% reported)
 - TRO analyzers creates difficulty, require constant cleaning
 - Maker has difficulty attends to the events and replacements
- Replenishment challenges (37% reported)
 - (13%) All consumables have been supplied
 - Low after sale quality
 - Limited supply network



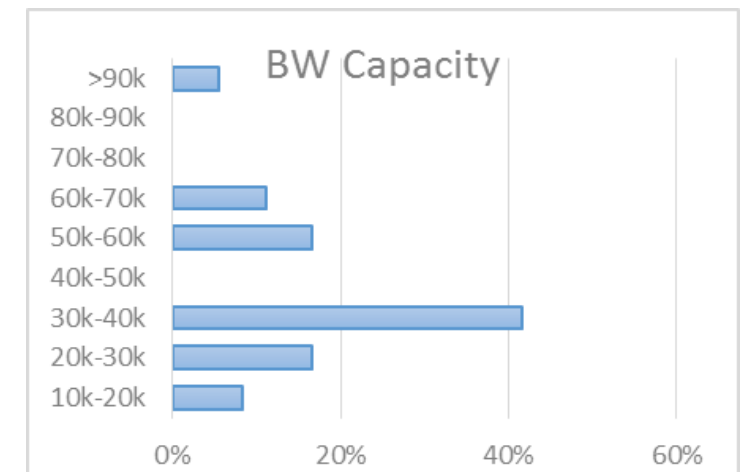
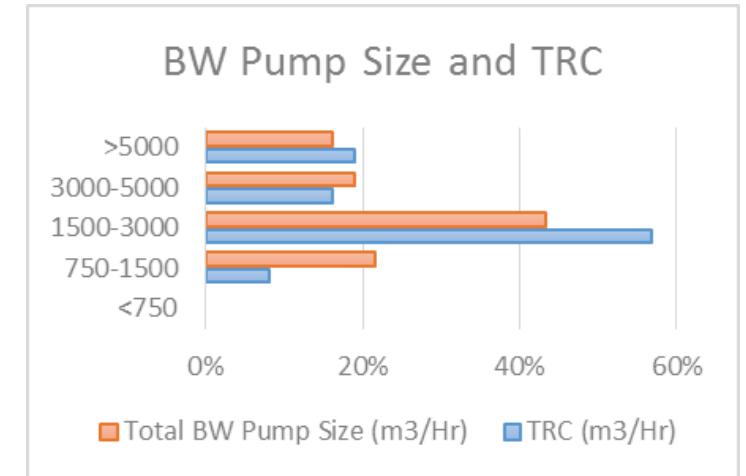
Filtration + Side-stream EC + Neutralization – 17%

- Hardware Failure (78% reported)
 - Flow meter faulty low reading that cause alarm
 - Fuse for rectifier
 - PSU flowmeter
 - Filter drain line holes
 - Valve actuator malfunction
 - Gas sensors malfunction
- Software Failure (81% reported)
- Human error (0% reported)
- Impact on coatings/pipes (0% reported)
- Health and Safety Issues (13% reported)
 - Chlorine and hydrogen gas production
- Reduction in Ballast rate (43% reported)
- Other issues/Challenges (67% reported)
 - Do not notify when working out of parameters
 - Calibration of various sensors
 - Mimic display is not user friendly



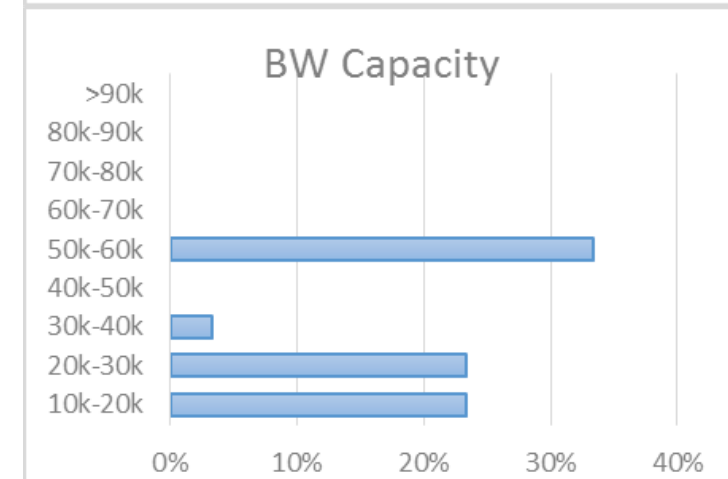
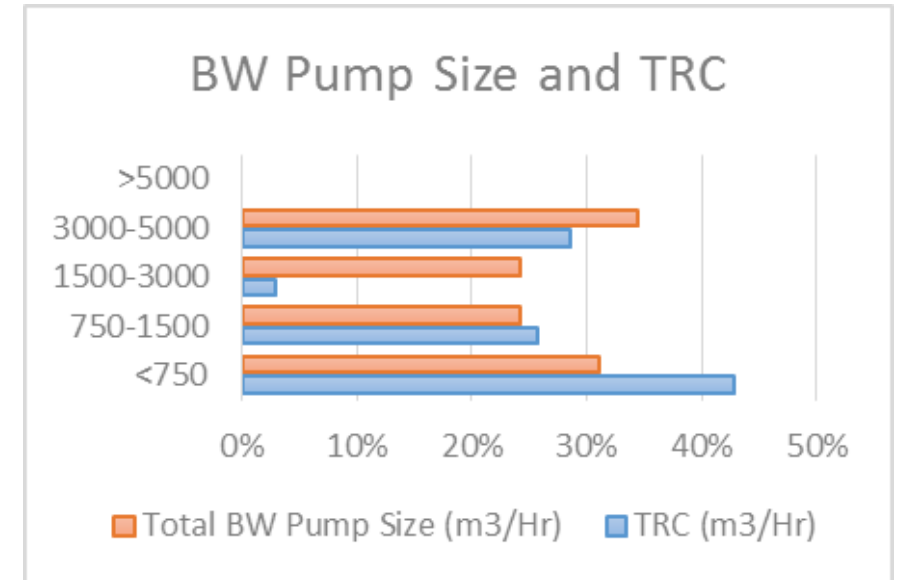
Filtration + Side-stream EC + Neutralization – 17%

- Corrective action and contingency measures (83% reported)
 - Fuse for rectifier
- Systems logs regularly monitored (89% reported)
- OMM completeness (97% reported)
 - (55%) Satisfied with the manual
- After sales service (86% reported)
 - (65%) Satisfied with the with spare parts
- Maintenance event, issues and challenges (65% reported)
 - Chlorine ppm slow to build up to required 5.5 ppm leading to shut down
 - Frequent false alarms distracting officers on critical cargo operation
 - Frequent shutdown of ballast pumps overheats the motor starter
 - Too many to log, recorded in planned maintenance system
- Replenishment challenges (38% reported)
 - TRO sensor agent kit need replacement every 3 months
 - TRO sensor reagents take too long to be delivered
 - Reagent limited lifetime, limited supply network



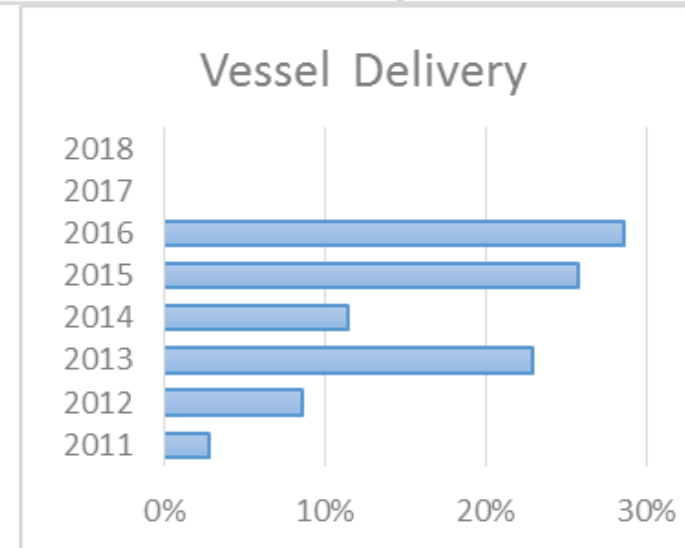
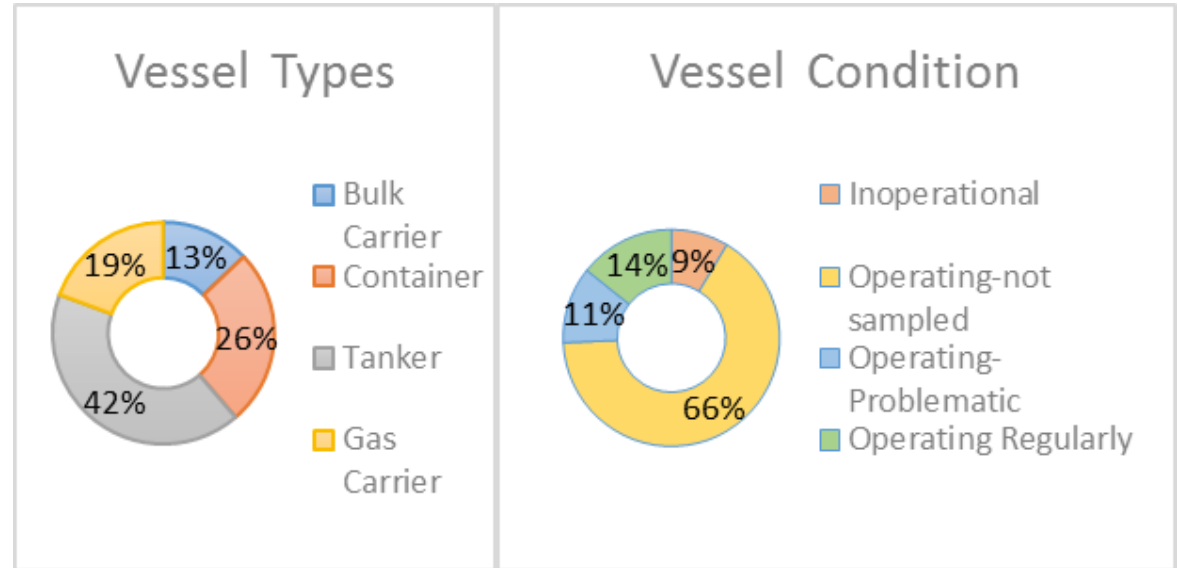
Filtration + UV Treatment – 16%

- Corrective action and contingency measures (74% reported)
 - Service engineer modified the program
- System logs regularly monitored (68% reported)
 - (22%) System logs satisfied
- OMM completeness (100% reported)
 - Considered useful
- After sales service (86% reported)
 - Availability is good
- Maintenance event, issues and challenges (77% reported)
 - Failure occurred on system's control panel
 - Software needed updating by maker
 - Filter cleaning / UV lamp replacement
- Replenishment challenges (61% reported)
 - Frequent failure of UV lamps
 - Spare parts are expensive
 - Vulnerable parts: UV sensors, the purge units and lamp wipers



Filtration + UV Treatment – 16%

- Hardware Failure (58% reported)
 - Burning of UV lamps
 - Frequent cleaning of UV lamps required
 - UV intensity meter sensor failure
 - Back-flush filter pressure switch broken
 - Control panel hard disk failure
 - Reactors flooding due to defective seals
- Software Failure (22% reported)
- Human error (38% reported)
- Impact on coatings/pipes (0% reported)
- Health and Safety Issues (0% reported)
- Reduction in Ballast rate (22% reported)
- Other issues/Challenges (64% reported)
 - Calibration of various sensors
 - Unable to use ballast-deballast by gravity method
 - Manpower required to operate manually operated valves



Resulting Best Practices

- **Installation:** Design and installation must consider maintenance and repair
- **Commissioning, Planning and Execution:** Critical to have clear agreement on responsibilities and extent of verification
- **Training:** Crew training covering safe and proper operation is essential
- **Operations:** BWM plan should clearly describe start up and shutdown sequences
- **Maintenance and Repair:** Maintain proper maintenance schedules and communicate with the system manufacturer about scheduling repairs
- **Contingency Measures:** BWM plan should anticipate measures to be taken including notifying and obtaining concurrence from the flag state and port



Thank You

www.eagle.org