Step to efficiency – Data Driven Condition Based Maintenance

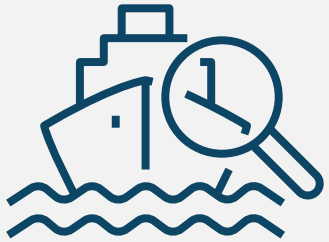
Benefits & Opportunities

Nikos Kakalis

Why DCBM?

Data-driven condition based maintenance

Significant benefits



Increase effectiveness

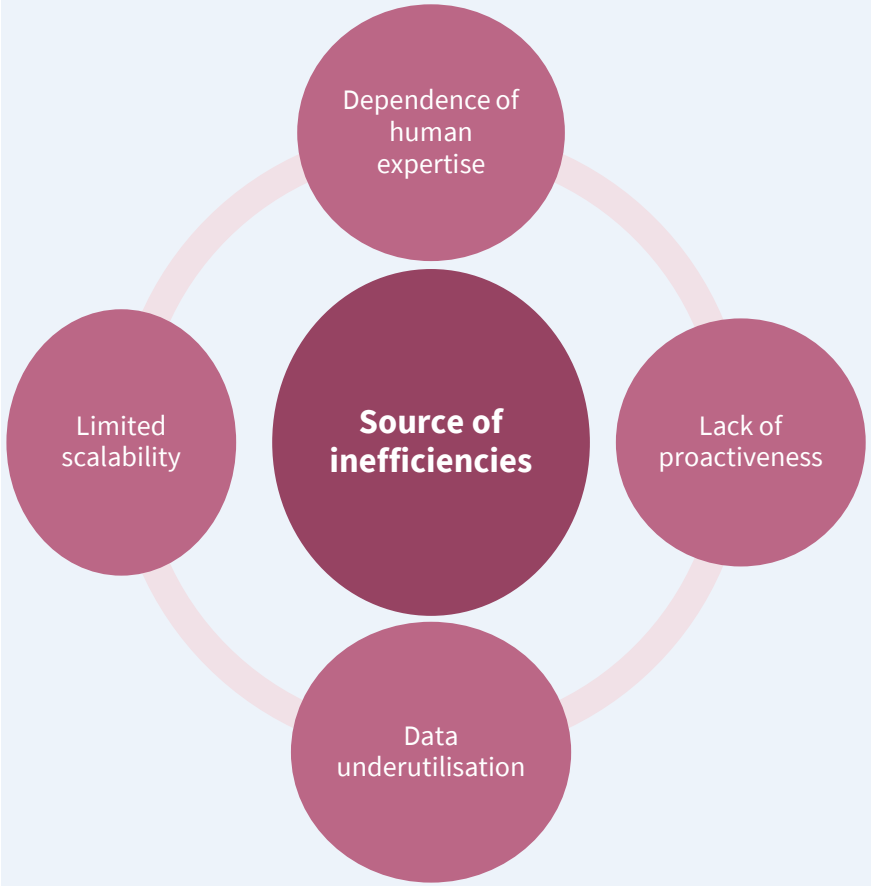
Improve efficiency

Critical for safety

Digital Transformation Research Programme

Condition based assessment & traditional approaches

Current maintenance practices present opportunities for optimisation:



- Scheduled inspections
- Subjective assessments
- Reactive maintenance
- Limited use of sensor data
- Documentation & record-keeping

Digital Transformation Research Programme

Data-driven condition-based maintenance (DCBM)

- Data & analytics-driven into the maintenance workflow
- DCBM process
- Analytics-based diagnostic systems
- Real-time monitoring solutions
- Comprehensive digital platforms
- Removing errors and inefficiencies
- Optimising workflows

Digital Transformation Research Programme

Four key challenges in condition-based maintenance

Challenge

1

Imprecise maintenance & inspection protocols

2

Deviations form scheduled maintenance & inspections

3

Accuracy in condition assessment (vague or undefined criteria for hazardous conditions)

4

Insufficient troubleshooting response (lack of structured response strategies for failures)

Improvement

Analytics-driven approach using historical and current operational data to refine & optimise maintenance schedules

Implementation of digital platforms to track and accurately record maintenance activities enabling automated tracking systems

Data analysis to uncover trends or early warning signs of unsafe operating conditions and potential system failures

Urgent need for research and development to create robust troubleshooting frameworks)

Machine Learning & Data-driven algorithms

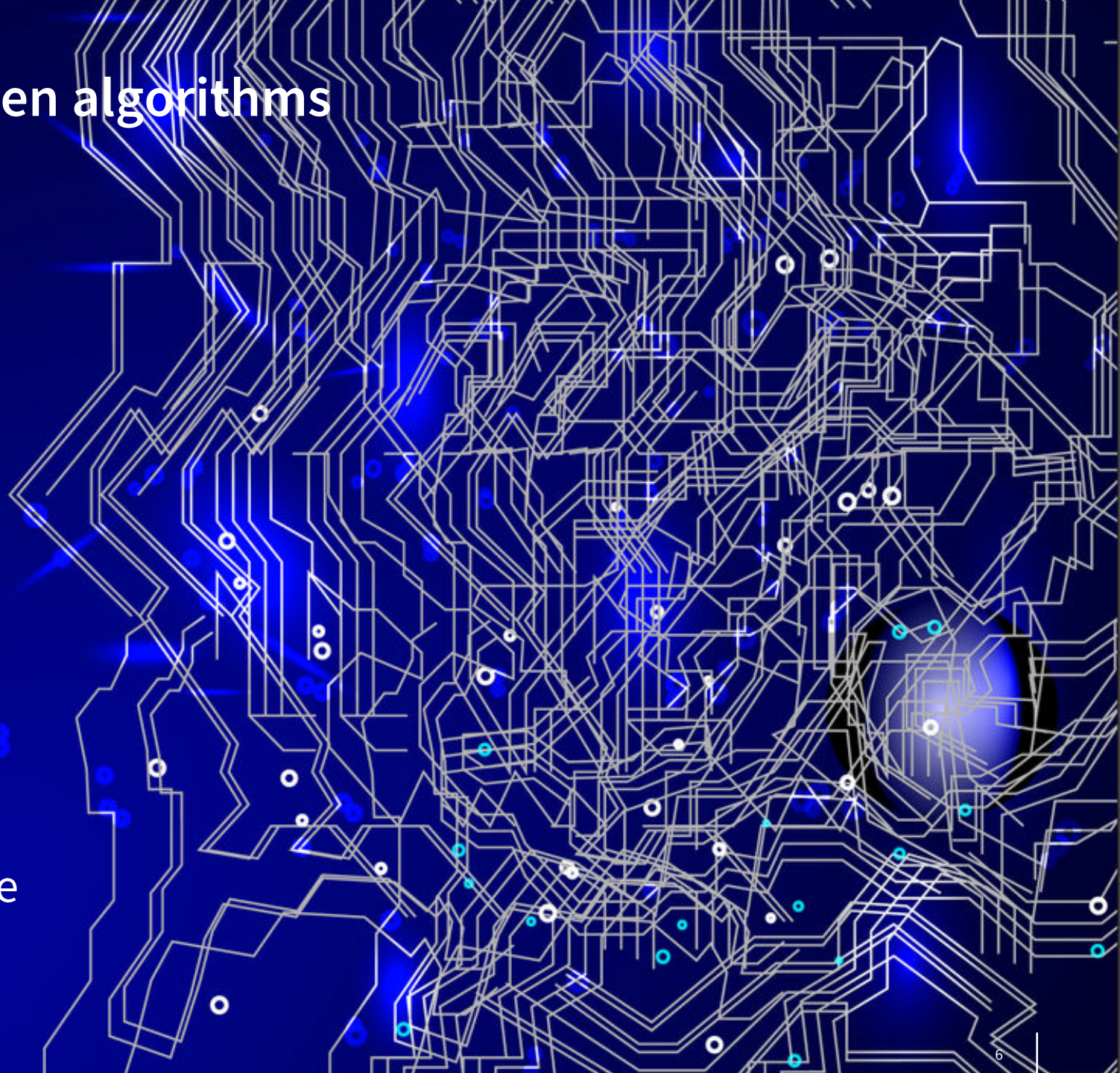
Connectivity

Sensors

Edge computing

Data quality

Human-machine interfaces



Drivers towards data-driven maintenance

Cost-efficiency and profitability

- Optimizes maintenance spending
- Minimizes unplanned downtime
- Improves operational flexibility

Environmental regulations

- Reduces fuel consumption and emissions
- Minimizes carbon footprint of spare parts and maintenance logistics

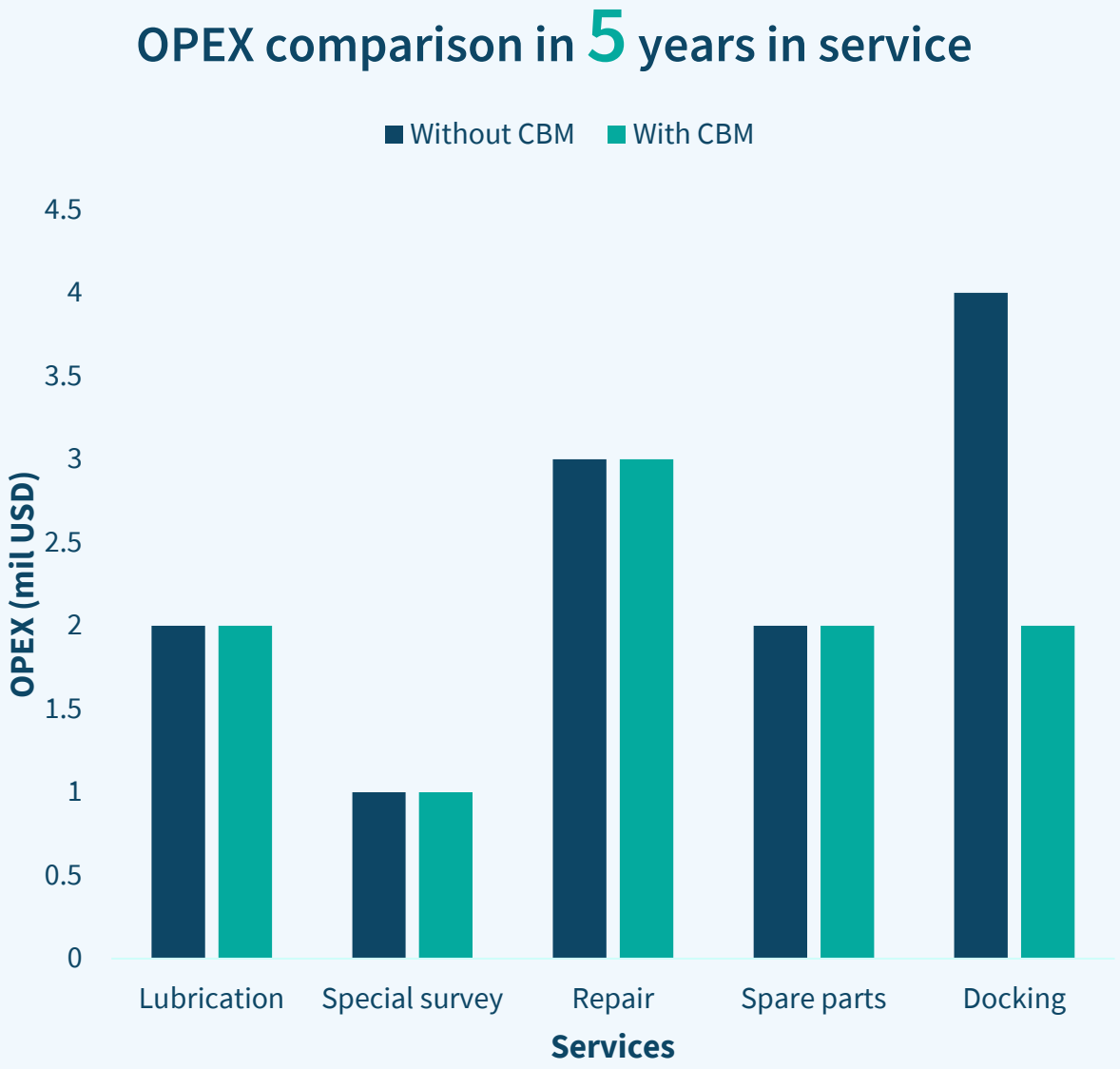
Safety & risk mitigation

- Enhances equipment safety
- Reduces likelihood of unscheduled downtime and failures
- Provides transparency in compliance processes
- Delivers improved confidence in vessel operations

Real-life OPEX benefits

Drivers for ship owners and operators

- Increased equipment availability
- Reduced downtime and lower maintenance costs
- Higher return on investment from assets
- Early detection of abnormalities
- Prevention of major breakdowns
- Flexible maintenance planning
- Reduced frequency of maintenance activities
- Significantly lower operational expenditure (OPEX) and crew workload



Digital Transformation Research Programme

Real-life OPEX benefits

Drivers for ship owners and operators

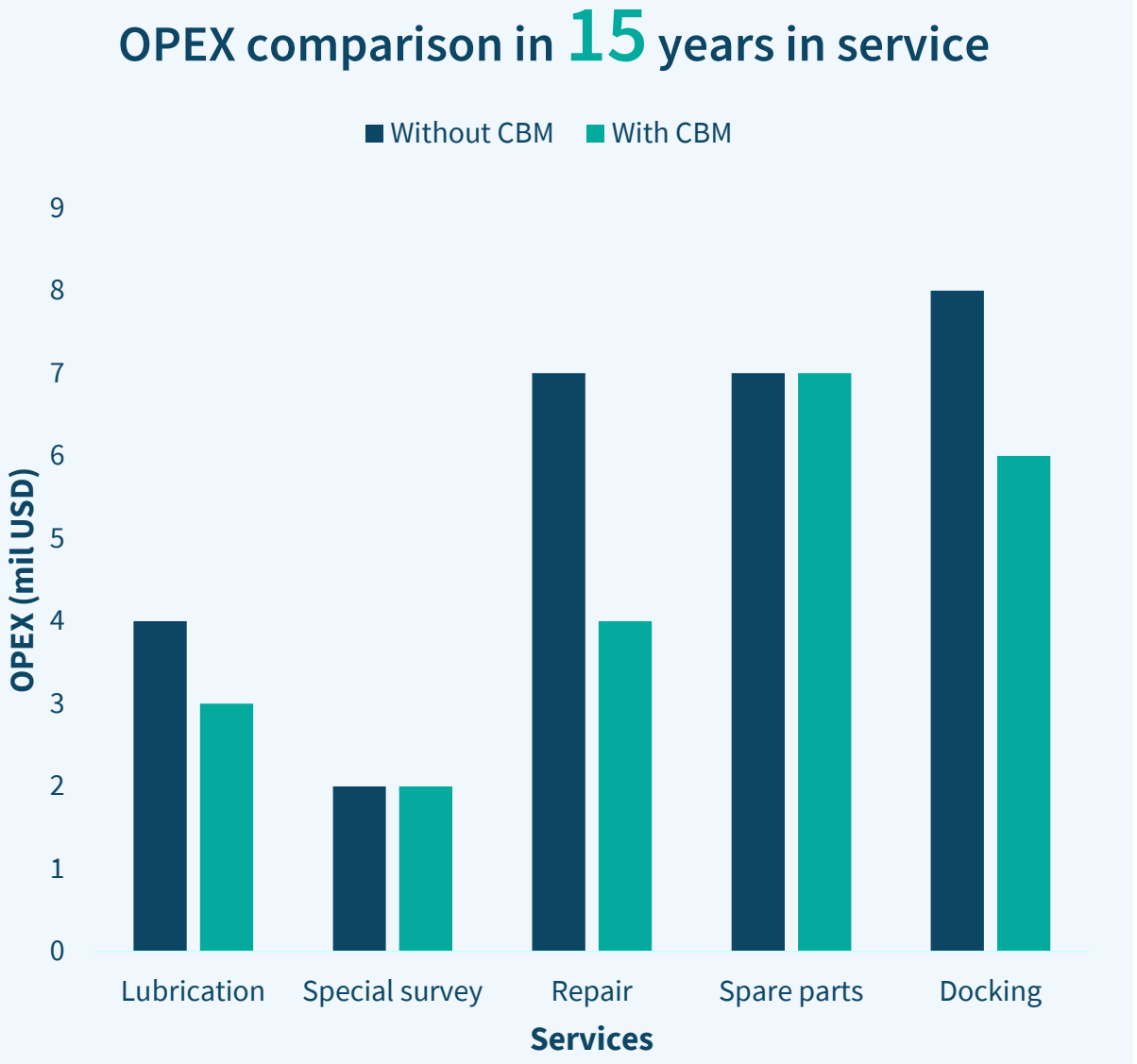
- Increased equipment availability
- Reduced downtime and lower maintenance costs
- Higher return on investment from assets
- Early detection of abnormalities
- Prevention of major breakdowns
- Flexible maintenance planning
- Reduced frequency of maintenance activities
- Significantly lower operational expenditure (OPEX) and crew workload

Digital Transformation Research Programme

Real-life OPEX benefits

Drivers for ship owners and operators

- Increased equipment availability
- Reduced downtime and lower maintenance costs
- Higher return on investment from assets
- Early detection of abnormalities
- Prevention of major breakdowns
- Flexible maintenance planning
- Reduced frequency of maintenance activities
- Significantly lower operational expenditure (OPEX) and crew workload

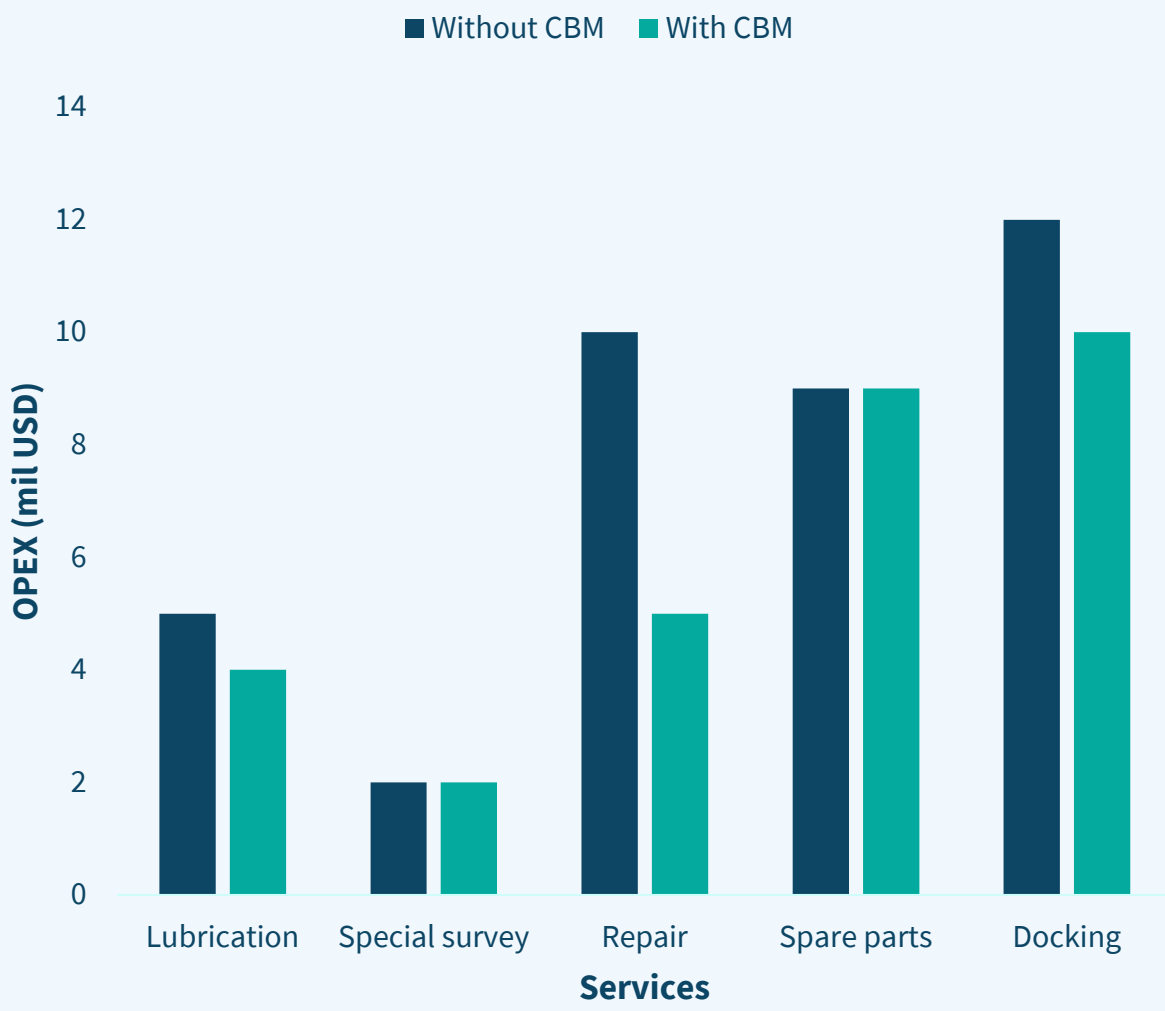


Digital Transformation Research Programme

Real-life OPEX benefits

Drivers for ship owners and operators

- Increased equipment availability
- Reduced downtime and lower maintenance costs
- Higher return on investment from assets
- Early detection of abnormalities
- Prevention of major breakdowns
- Flexible maintenance planning
- Reduced frequency of maintenance activities
- Significantly lower operational expenditure (OPEX) and crew workload



Digital Transformation Research Programme

Implementing data-driven maintenance processes

Key take aways

Opportunity to transform operations through data-driven Condition-Based Maintenance (DCBM)

Shipowners Ship managers	Classification societies	Original Equipment Manufacturers
significant ROI through reduced and optimised operational costs	more intelligent and effective inspection regimes	opportunity to deliver data-driven value-added services

DCBM benefits

enhancing **safety**, securing **competitive advantage**, reducing overheads, delivering **excellence** in operations

Digital Transformation Research Programme

Thank you

Nikos.Kakalis@lr.org