

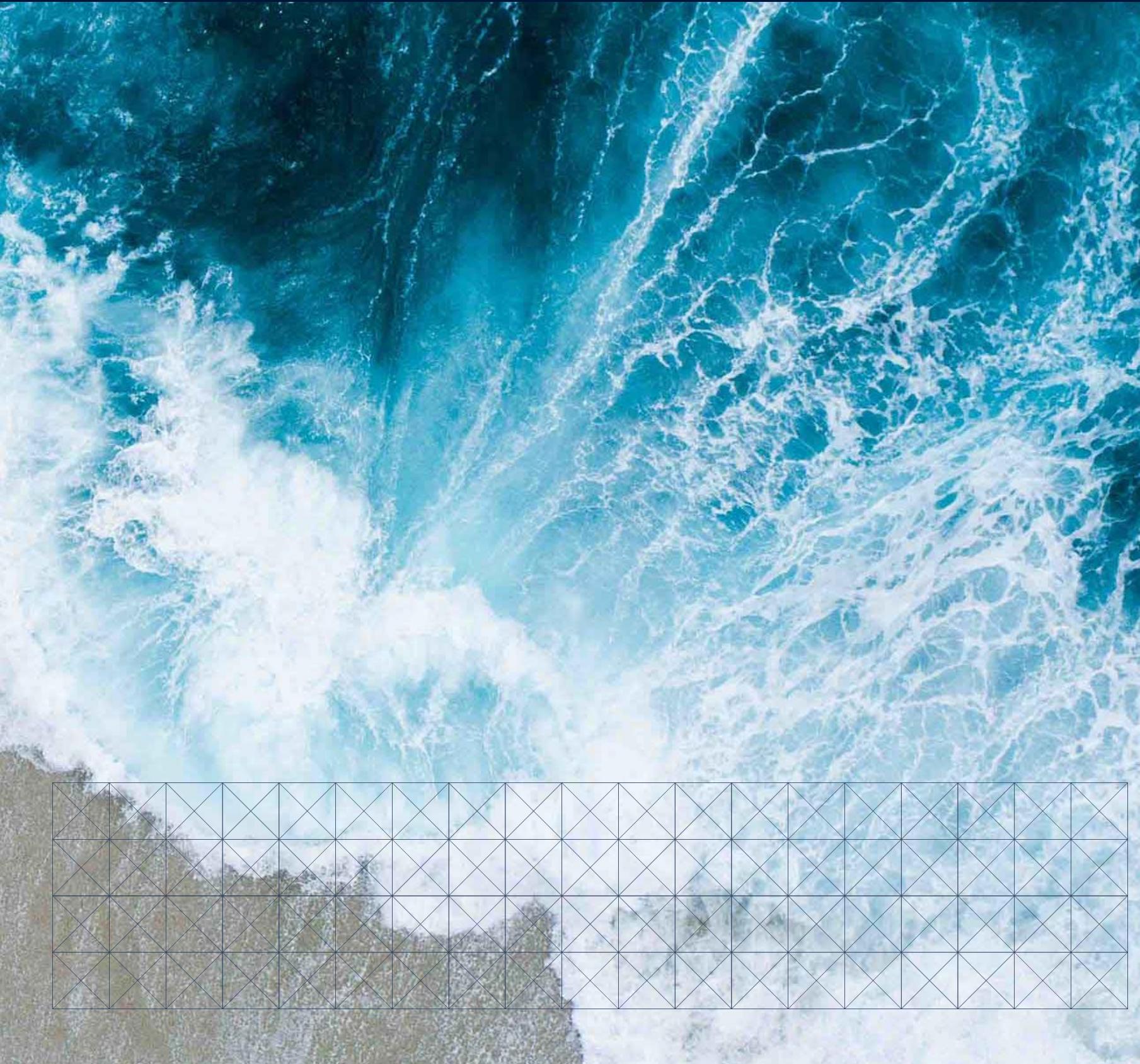
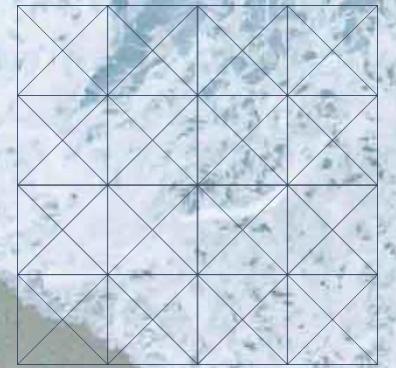


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Dynamic Digital Twins

26/10/2018



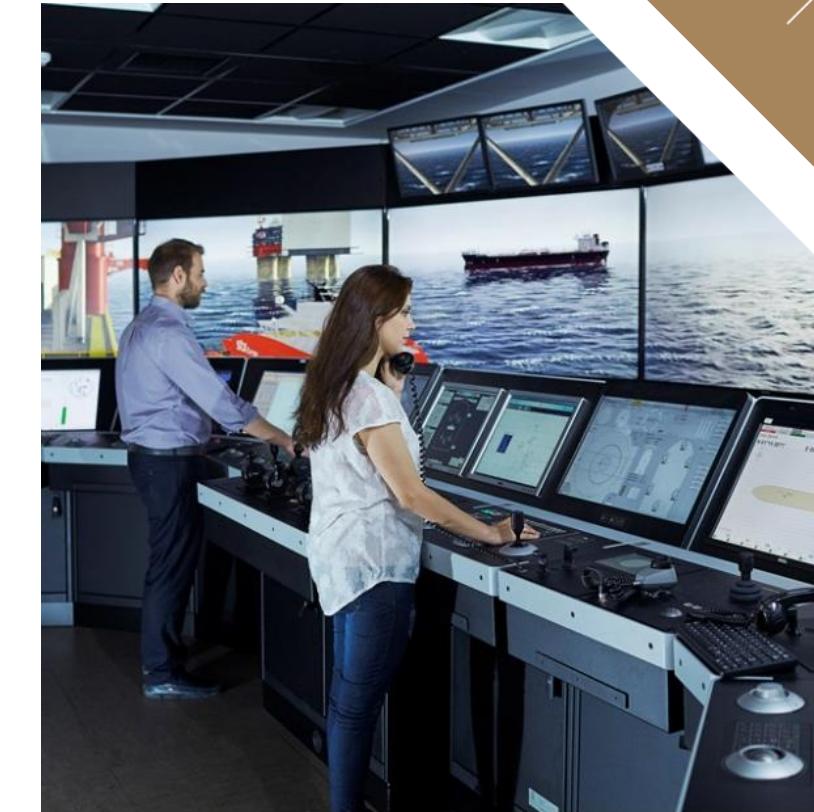
Hege Skryseth President Kongsberg Digital



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Kongsberg Digital

Digital transformation
with deep domain- and
digital competencies



- Oil & Gas
- Renewables & Utilities
- Maritime Simulations
- Maritime Eco-system
- Digital Platform

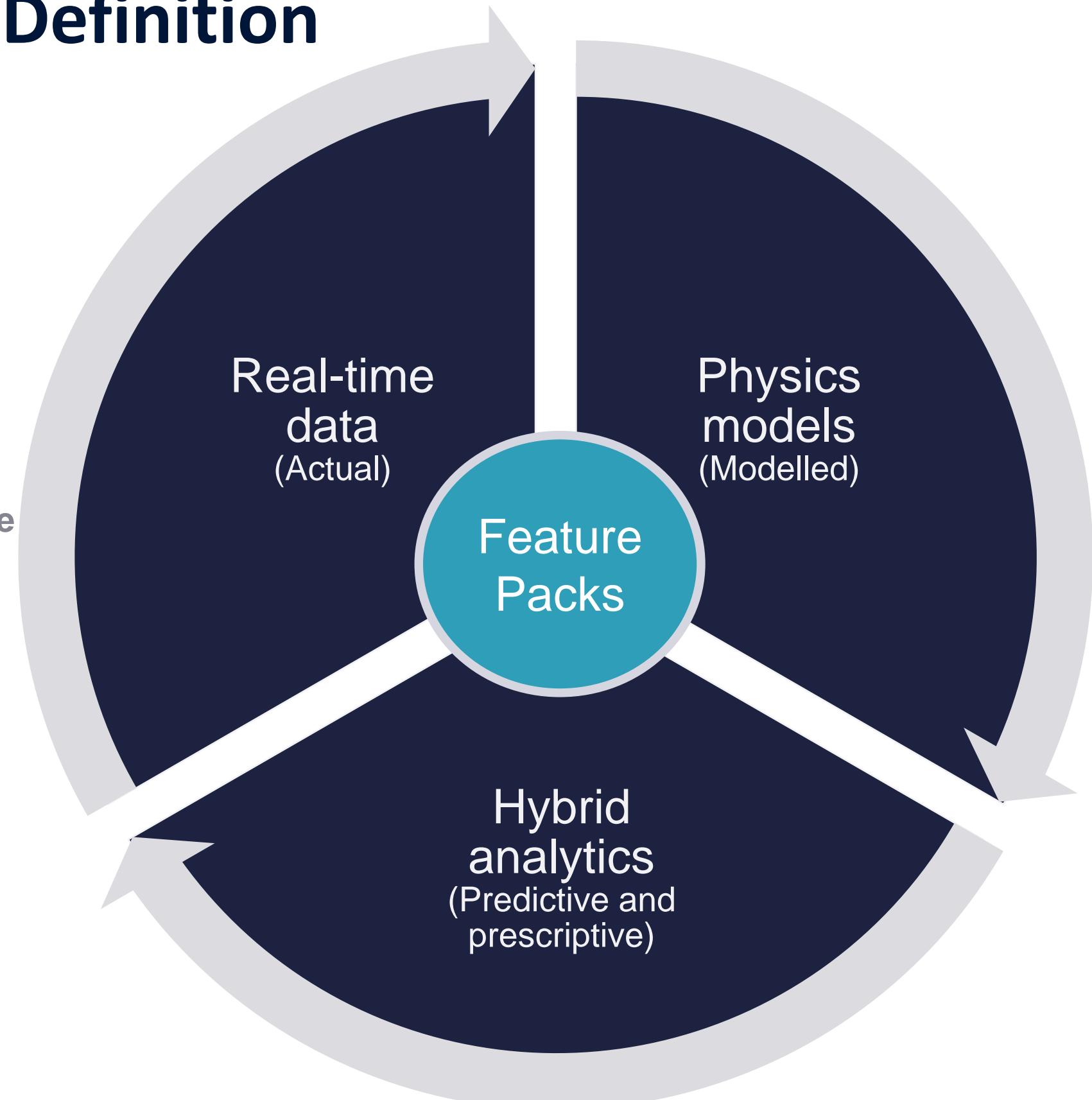




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Digital Twin Definition

Our dynamic Digital Twin solution is defined by its three intertwined dimensions...



...powering feature packs that are easily available through any web browser or app on your preferred device



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Feature Pack examples

Example 1

Feature Pack

Collaborate with Actual State and Modelled State

Themes: Safe Operation, Production Optimization, O&M Cost Reduction, Carbon Footprint

Lifecycle: Early Phase / Concept (Greenfield & Mod), Design & Engineering, Commissioning, Operations & Maintenance

Roles: Process Engineer, Maintenance Planner, Maintenance Crew, Operations Center, Expert Center, Central Room Operator, Energy Management, Production Optimization, Asset Stakeholders, Maintenance Planners

Overview

Provides common situational understanding and enhanced collaboration between a broad set of roles, including people working directly with assets onshore and offshore, as well as supporting and leadership functions across operations centers, expert centers and offices. User friendly visualization of the facility and its "actual state" and "modelled state" through intelligent 2D and data enriched 3D. Core functionality includes ability to quickly navigate between views while remaining in context, compare actual state (sensor readings) with modelled state (model readings), and get insight to parts of the facility that is not instrumented (virtual sensors).

Functionality

- Easy access through your Web browser or App on your preferred device
- Utilize the Actual State and Modelled State dimensions of the Digital Twin
- Intelligent 2D and Live P&ID's, with contextual link to and from 3D
- Data enriched 3D with the ability to efficiently navigate very large models, with dynamic resolution depending on your zoom level
- Compare actual state and modelled state, get notifications and events related to deviations between the two
- Insight to non-instrumented parts of the facility, including Virtual Sensors

Value

- Safe Operations: Support the decision-making process with the right information to the right time (i.e. Right Time Decision).
- Production Optimization: Increased level of detailed view will give better foundation to the right optimization actions (i.e. Identify bottlenecks and limitations in the process)
- O&M Cost Reduction: Test and validate before implement and execute.
- Carbon Footprint: Monitor and understand the potential in reduced emission

Feature Pack

What-If for Operations

Themes: Safe Operation, Production Optimization, O&M Cost Reduction, Carbon Footprint

Lifecycle: Early Phase / Concept (Greenfield & Mod), Design & Engineering, Commissioning, Operations & Maintenance

Roles: Process Engineer, Maintenance Planner, Maintenance Crew, IOC Personnel, Expert Center Personnel, CCR Operator, Energy Management, Production Optimization, General JS Stakeholders, Maintenance Planners

Overview

Enable operators to perform What-If analysis before performing an operation. Answers the questions: What happens if I do this? What are the outcomes of various combinations of set points and parameters? Utilizes the power of the "predicted state" dimension in the Digital Twin, giving operators an easy way to dynamically spin up one or multiple instances of On Demand models to perform What-If analysis. Drive safe operations, reduce risk by letting the operator evaluate outcomes before taking actions in an operations and maintenance context, and it is valuable when working with production optimization.

Functionality

- Easy access through your Web browser or App on your preferred device
- Utilize the Predicted State dimension of the Digital Twin, and the model engine with auto-launching of On Demand models
- Spin up one or multiple instances of On Demand models to perform What-If

Value

- Safe Operations: Reduce risk by letting the operator evaluate outcomes before taking actions
- Production Optimization: Let operators analyze various scenarios before taking production optimization measures
- O&M Cost Reduction:
- Carbon Footprint:

Example 2

Feature Pack

What-If for Optimizing Production

Themes: Safe Operation, Production Optimization, O&M Cost Reduction, Carbon Footprint

Lifecycle: Early Phase / Concept (Greenfield & Mod), Design & Engineering, Commissioning, Operations & Maintenance

Roles: Process Engineer, Maintenance Planner, Maintenance Crew, IOC Personnel, Expert Center Personnel, CCR Operator, Energy Management, Production Optimization, General JS Stakeholders, Maintenance Planners

Overview

Enable operators to perform What-If analysis to identify bottlenecks, find ways to increase throughput and allow operations closer to limits. Utilizes physical/mathematical models and what-if scenarios to validate proposed optimization settings from AI models through hybrid analytics.

Functionality

- Easy access through your Web browser or App on your preferred device
- Utilize the Actual State and Modelled State dimensions of the Digital Twin
- Validates AI model output through hybrid analytics

Value

- Safe Operations: Reduce risk by letting people working with optimizing production to evaluate scenarios and outcomes before taking actions
- Production Optimization: Bottleneck identification, increased throughput and operations closer to limits.
- O&M Cost Reduction:
- Carbon Footprint: A parameter

Feature Pack

Predictive maintenance

Themes: Safe Operation, Production Optimization, O&M Cost Reduction, Carbon Footprint

Lifecycle: Early Phase / Concept (Greenfield & Mod), Design & Engineering, Commissioning, Operations & Maintenance

Roles: Process Engineer, Maintenance Planner, Maintenance Crew, IOC Personnel, Expert Center Personnel, CCR Operator, Energy Management, Production Optimization, General JS Stakeholders, Maintenance Planners

Overview

Present key performance data to IOC personnel. Actual state and modelled state based condition monitoring. Utilize data from performance monitoring solution. Utilize the Actual State and Modelled State dimensions of the Digital Twin. Validates AI model output through hybrid analytics.

Functionality

- Easy access through your Web browser or App on your preferred device
- Utilize the Actual State and Modelled State dimensions of the Digital Twin
- Validates AI model output through hybrid analytics

Value

- Safe Operations: Reduce risk by letting the operator evaluate outcomes before taking actions
- Production Optimization: Let operators analyze various scenarios before taking production optimization measures
- O&M Cost Reduction:
- Carbon Footprint:

Example 3

Example 4



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Digital Twin

Transforming workflows

SYSTEM WARNING

ASSET: Krafla

TASK SUBJECT: Equipment failure

OWNER: Name: Heidi Drumm
Role: Platform Leader

TASK ID: #233406

Part ID: Gas release valve #3457

VOLUME INCREASE: 15 %

Gas release valve #3457 [View History](#)

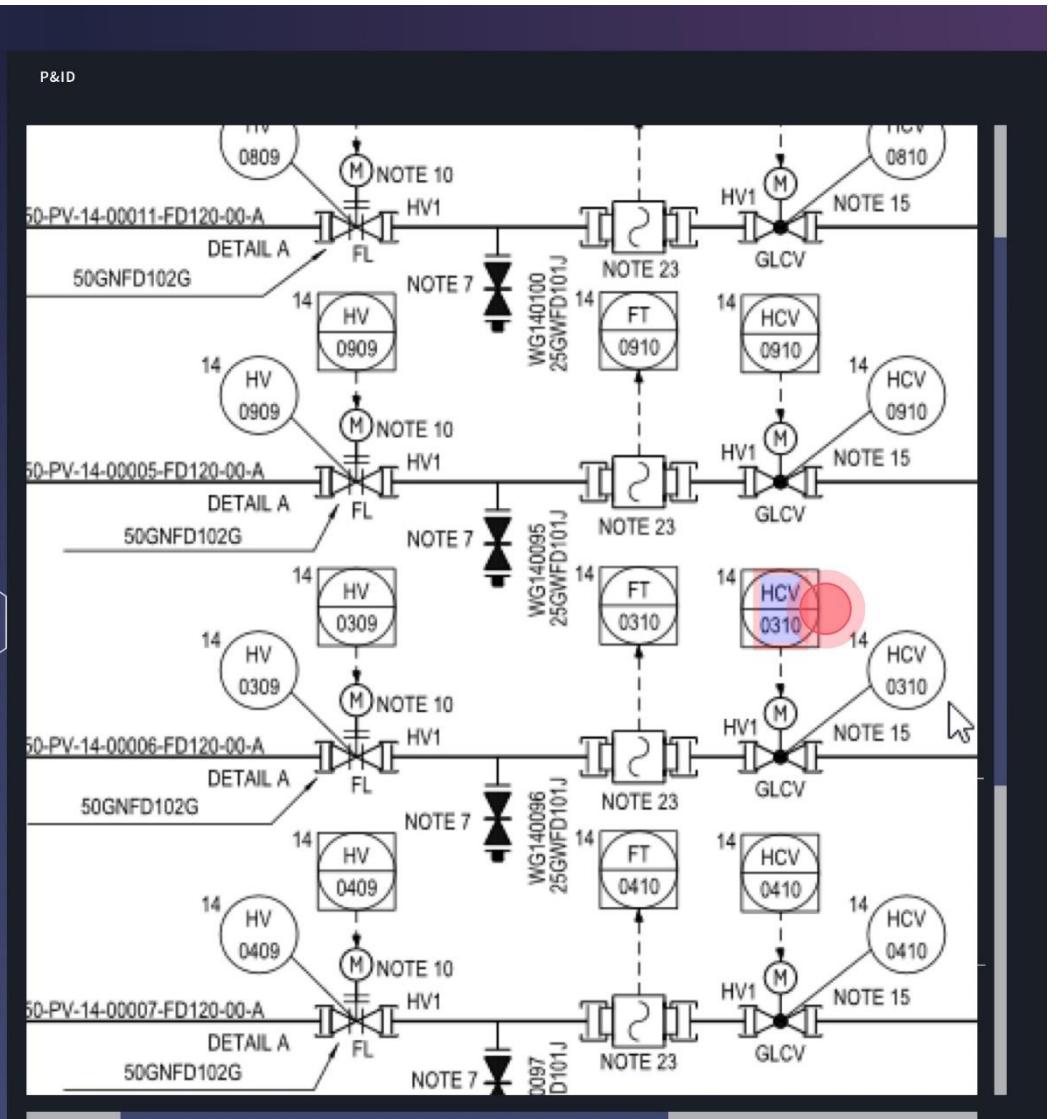
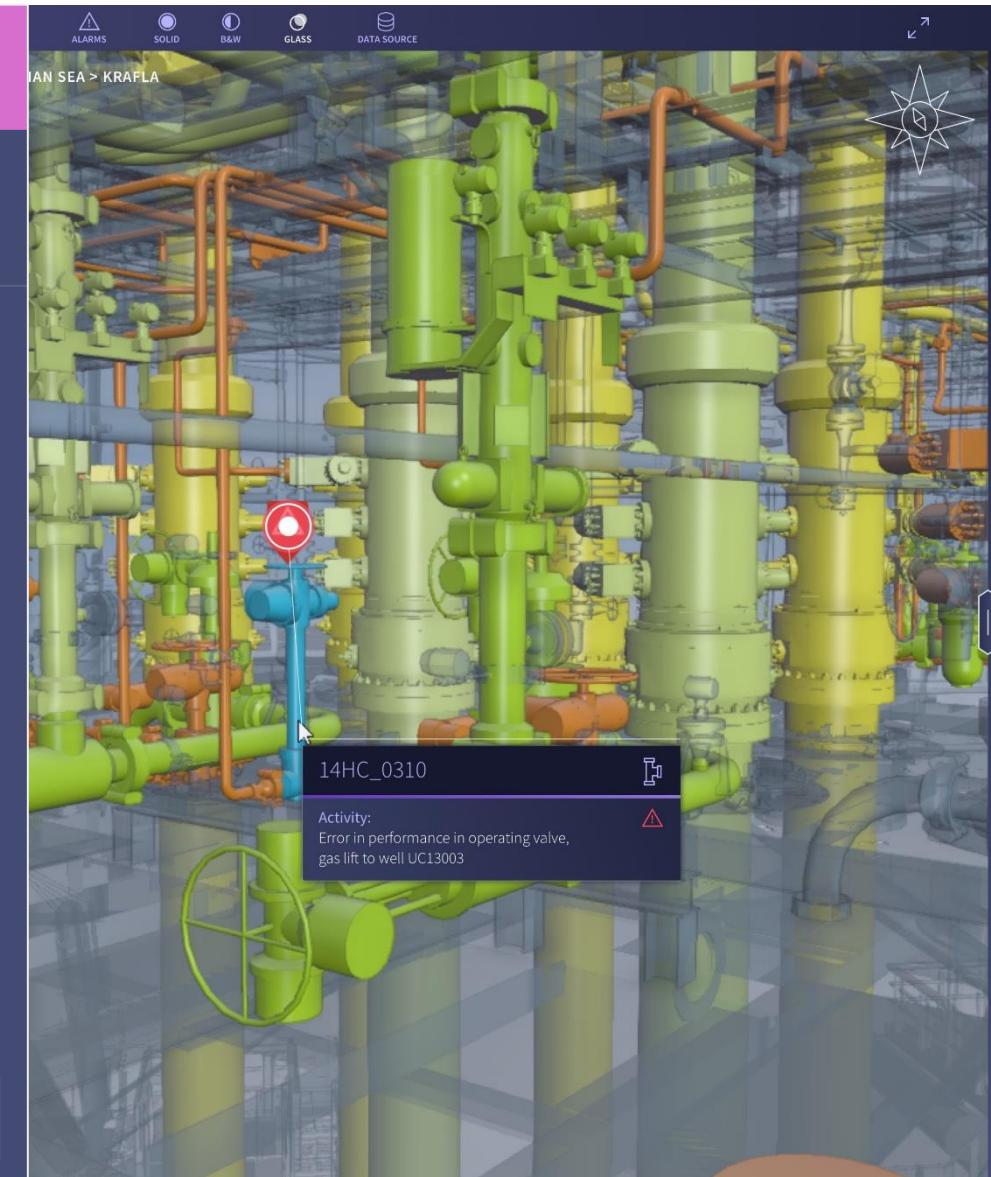
LIMITATIONS: None

PRIORITY: HIGH

ASSIGN TO: Production team 2

TASK DESCRIPTION: SYSTEM WARNING: Equipment failed to comply with input parameters.

CONFIRM





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Digital Twin

Transforming workflows

COMPONENT ID #L33TSUPAH4X0L

3D

HEALTH 20%

LIFE EXPECTANCY

LOG

What	When
Installation	2015
Regular maintenance	2016
Emergency maintenance	2017

DIGITAL TWINS UNLOCK SIGNIFICANT VALUE FOR OPERATORS ACROSS THE VALUE CHAIN - EXAMPLES

Upstream value chain



Capital project delivery

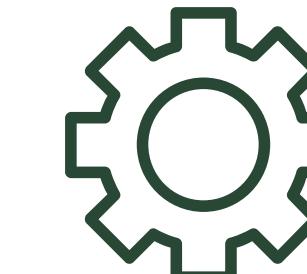
- 30% - 70% reduction of engineering cost and time
- Reduced materials costs
- Labor man hours reduced by 30-80% across multiple key processes



-30% cost
-30% time

Operations and maintenance

- 5-15% higher production by higher uptime and prevention of unplanned events and failures
- 20-40% reduced maintenance costs
- 30-100% reduction of offshore manning



+10 % prod.
- 20-60% cost



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Digital Twins and remote operations of unmanned facilities

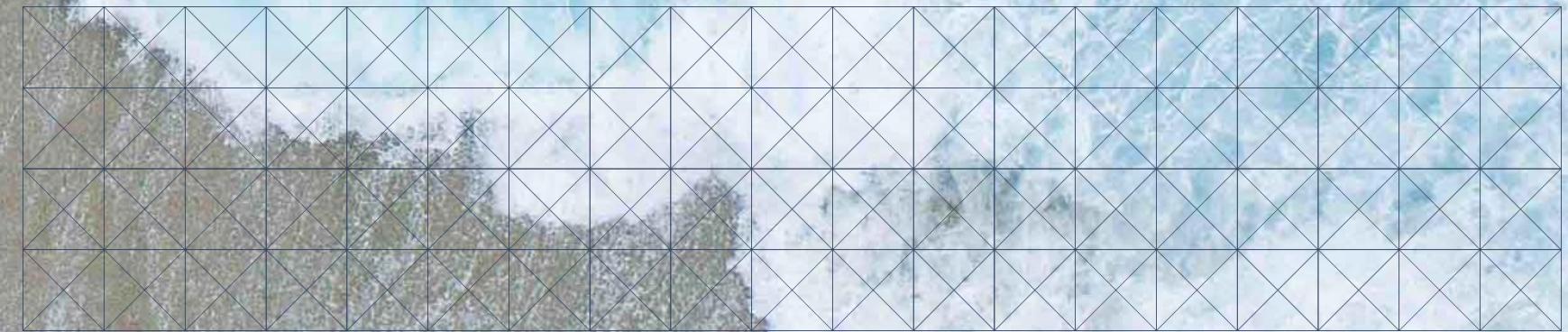
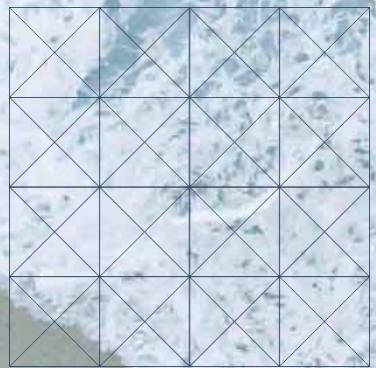


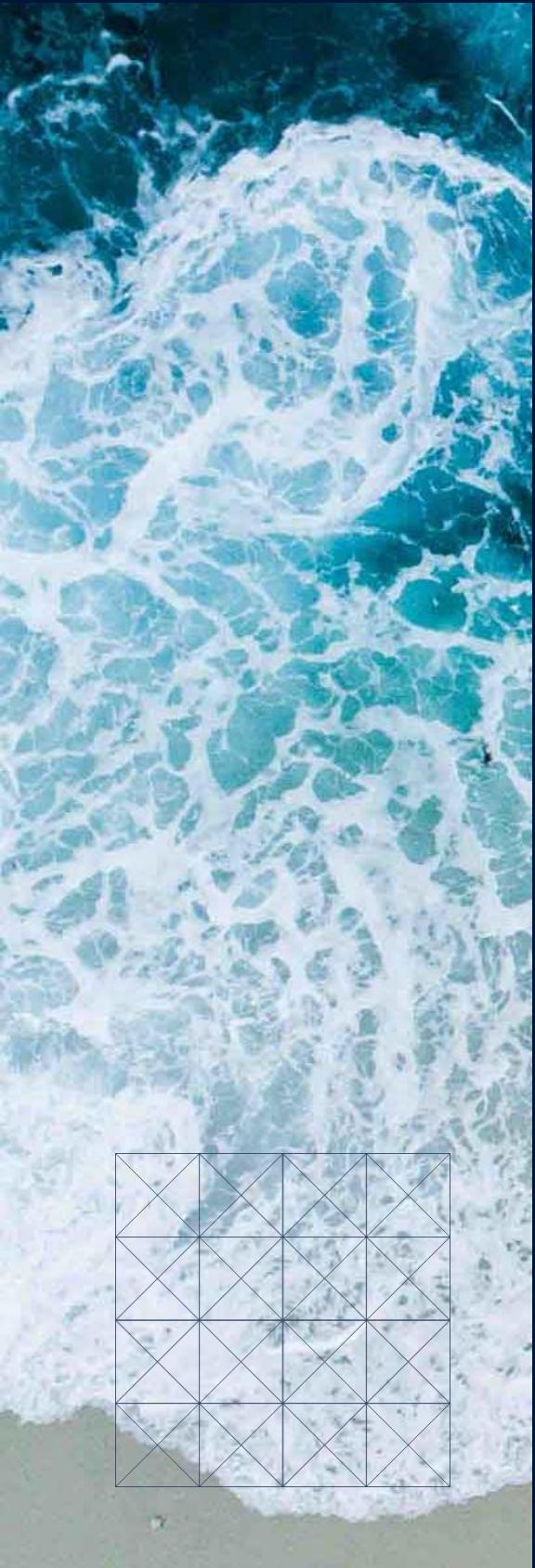
Digital Twin-film



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Thank you



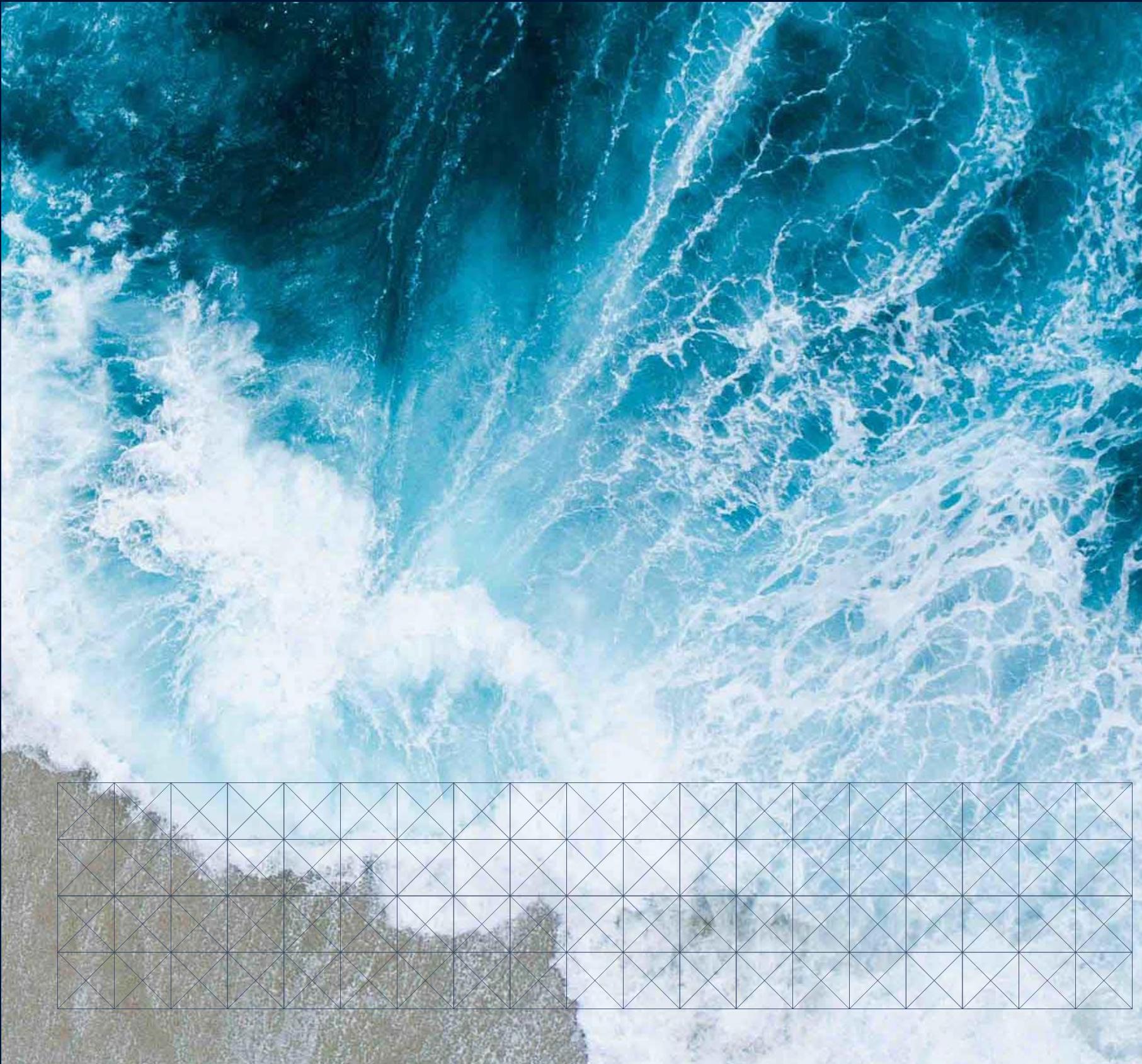


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Kongsberg Defence & Aerospace

26/10/2018

President & Group EVP Eirik Lie





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KONGSBERG DEFENCE & AEROSPACE

KEY FIGURES

33 offices in 17 countries

2,600 employees

Revenues LTM 6.5 BNOK

Order backlog 10.5 BNOK

International success in selected niches



INTEGRATED
DEFENCE SYSTEMS
System: Land, Sea, Air



MISSILE SYSTEMS



SPACE &
SURVEILLANCE



AEROSTRUCTURES



DEFENCE
COMMUNICATIONS



PROTECH SYSTEMS



PATRIA



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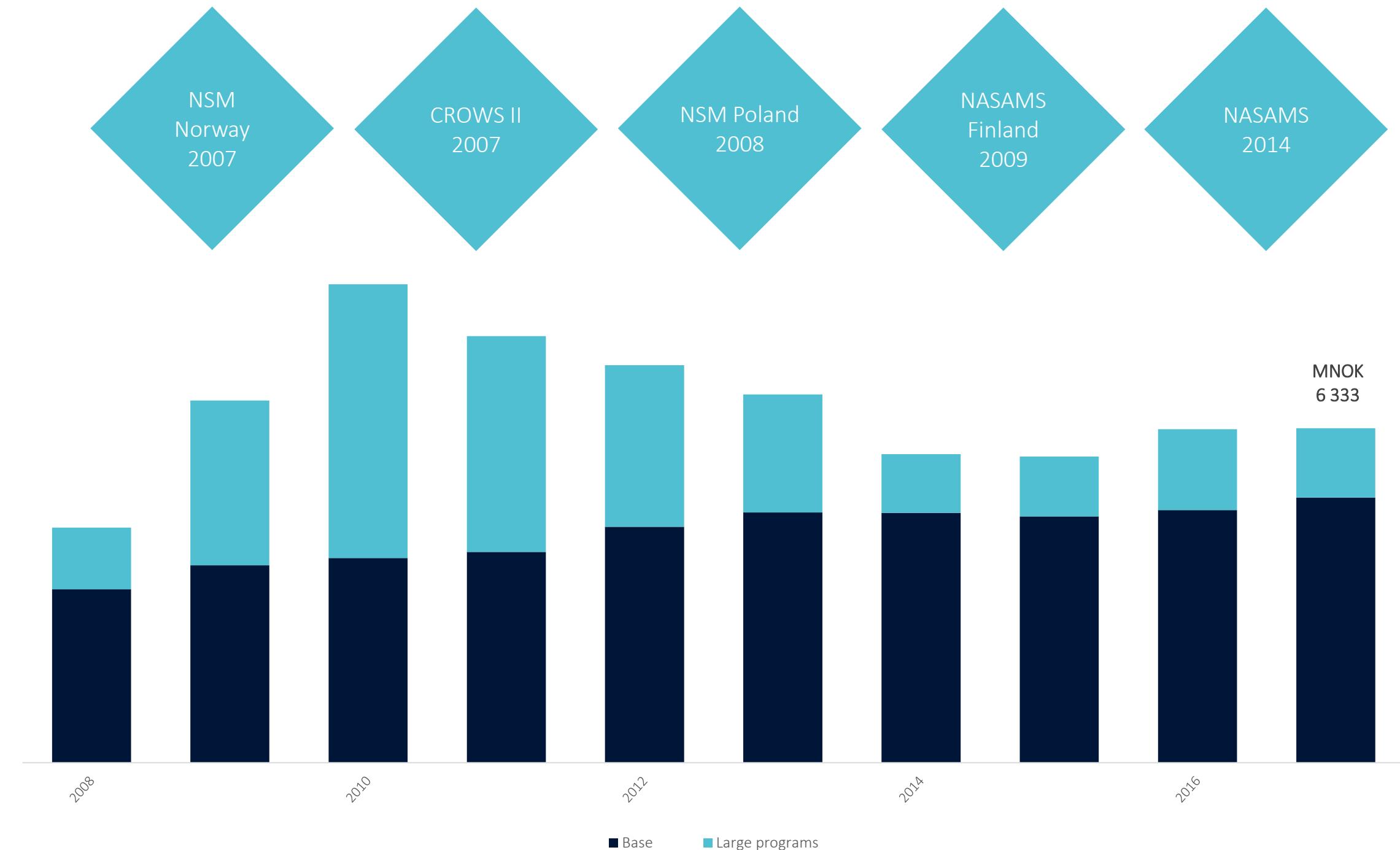
INCREASE MARKET PENETRATION WITH A MODERN PRODUCT PORTFOLIO





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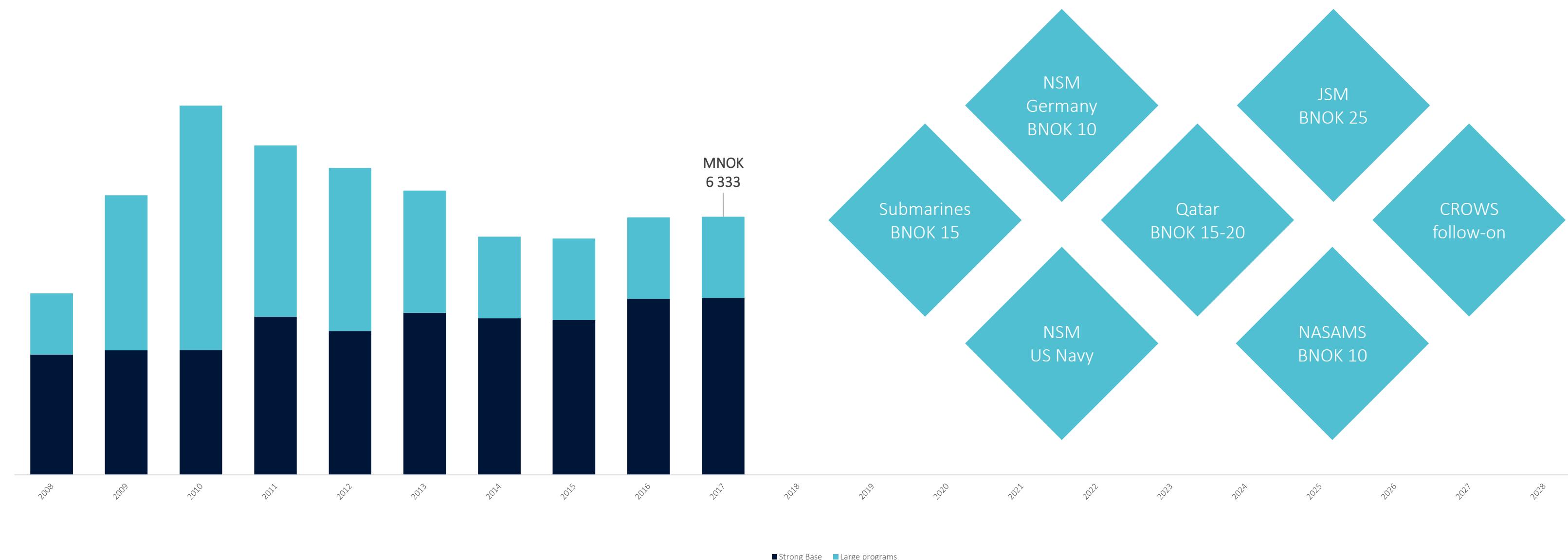
STEADY GROWING BASE





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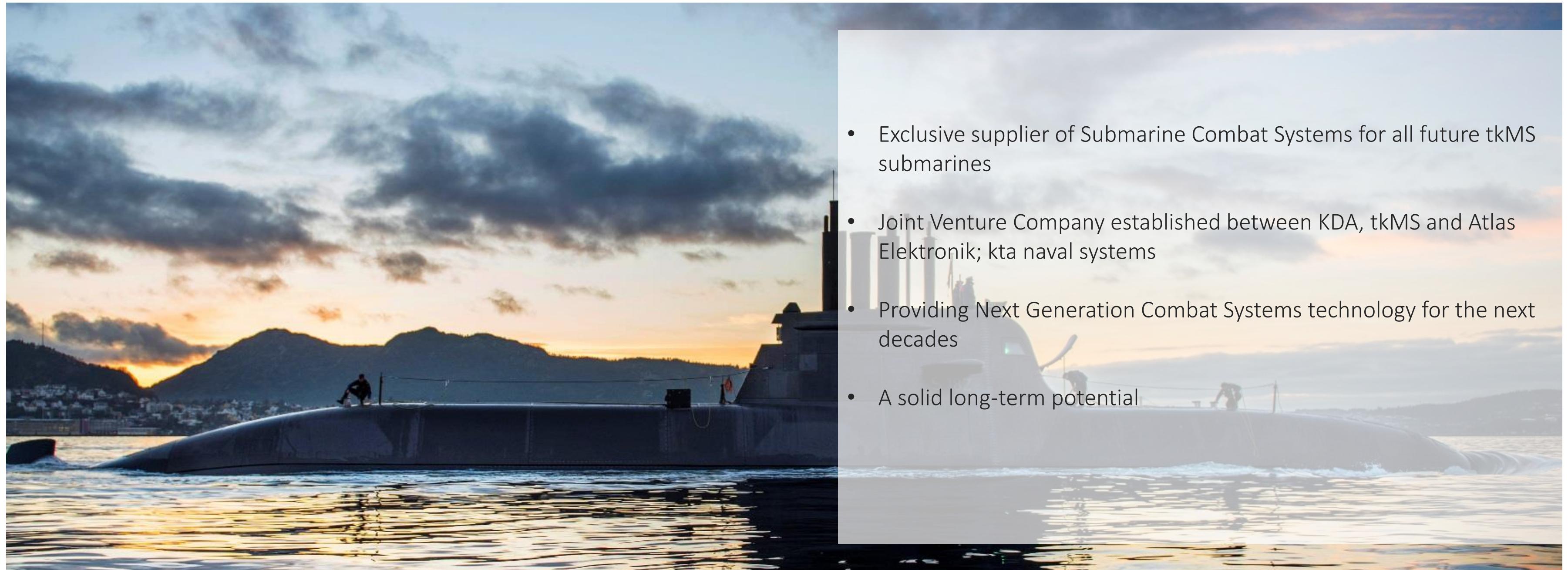
SECURED POSITIONS FOR FUTURE GROWTH





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PARTNERING WITH tkMS TO PROVIDE SUBMARINE COMBAT SYSTEM



- Exclusive supplier of Submarine Combat Systems for all future tkMS submarines
- Joint Venture Company established between KDA, tkMS and Atlas Elektronik; kta naval systems
- Providing Next Generation Combat Systems technology for the next decades
- A solid long-term potential



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US NAVY has contracted
NSM for Littoral Combat
Ships and Future Frigates



German NAVY has selected NSM
for its Harpoon replacement





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QATAR MAJOR OPORTUNITIES WITHIN SEVERAL FIELDS



Major vehicle program in Qatar

- Program announced 13 March 2018
- KONGSBERG selected to supply medium calibre turrets, remote weapon stations and other essential parts of the program
- Ongoing negotiations
- Total scope still to be defined, BNOK 15 estimated potential
 - Upside of up to BNOK 5 announced on Q2 2018 depending on ongoing scope- and price negotiations

Air defence program – NASAMS to Qatar

- Raytheon has announced MoU for a major NASAMS system
- KONGSBERG is exclusive partner on the NASAMS system
- Potential of USD 2 Billions on total program according to Raytheon
 - Typical KONGSBERG scope 30-40%



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JSM – THE ONLY LONG RANGE PRECISION STRIKE MISSILE BEING INTEGRATED ON F-35



- Offered and Supported as standard F-35 weapon
- The only long range precision strike missile being integrated on F-35
- On track with missile development and flight testing
- Significant market potential with an increasing base of F-35 customers



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TEAMING AGREEMENT WITH RAYTHEON AIR DEFENCE HAS GENERATED SOLID REVENUES OVER DECADES



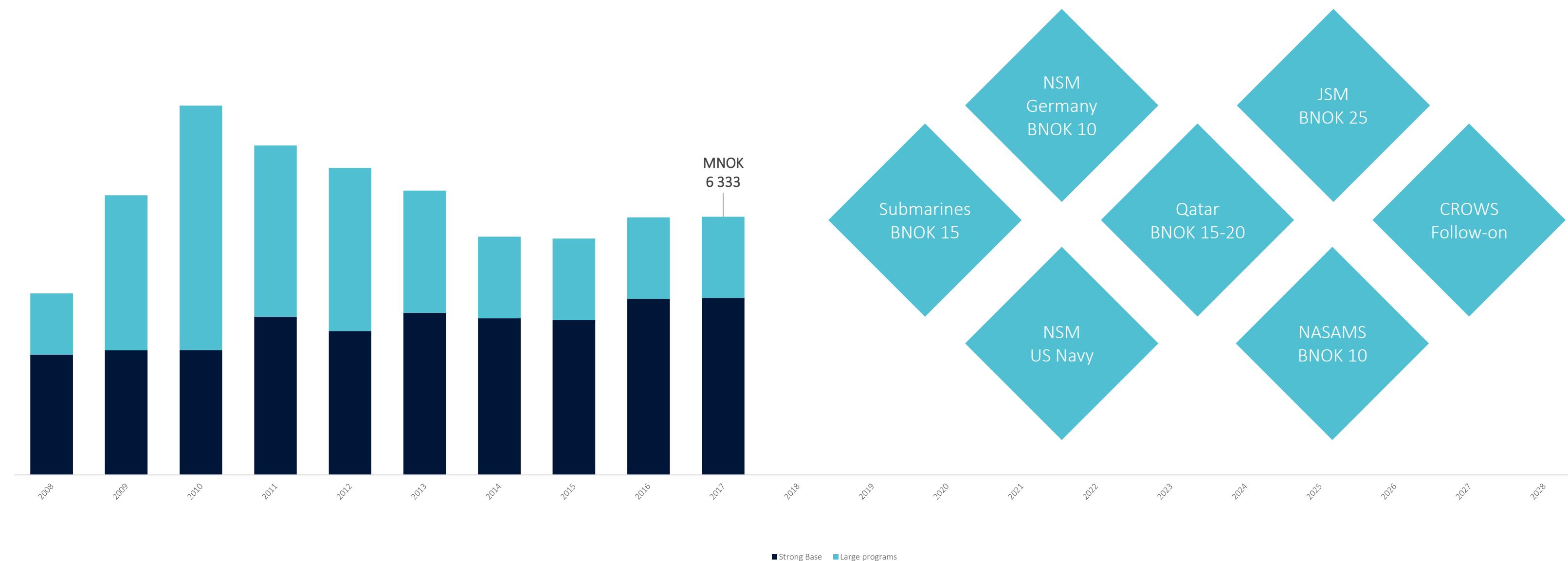
Raytheon

- 20 years Teaming Agreement with Raytheon
- NASAMS is the most sold Air Defence system in NATO
- NASAMS deployed in Washington DC since 2005
- NASAMS is unique with its network architecture, high firepower and dual-use of effector
- Increased demand for this fundamental defence capability
- Selected in Australia
- Selected in Qatar
- Selected as Mobile Ground Based Air Defence System for Norwegian Army



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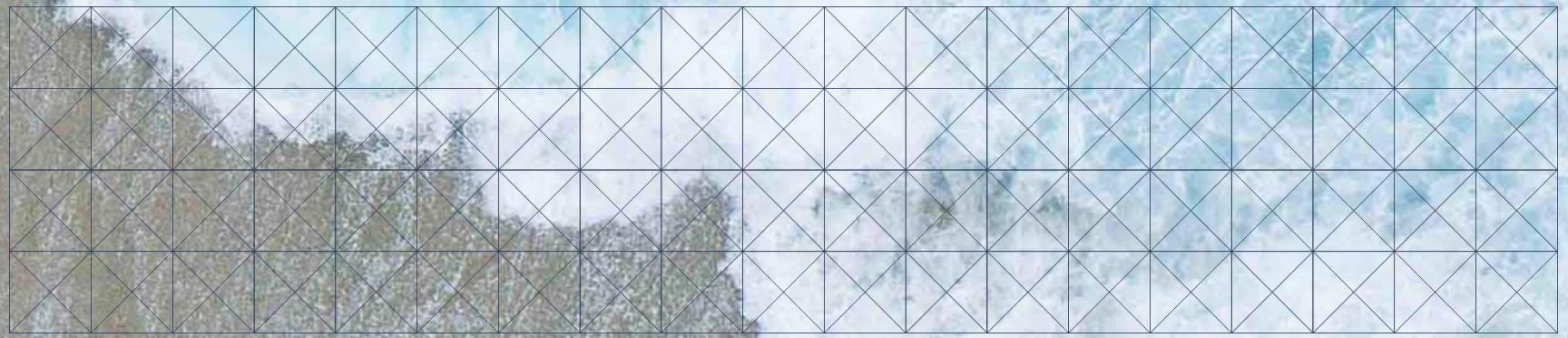
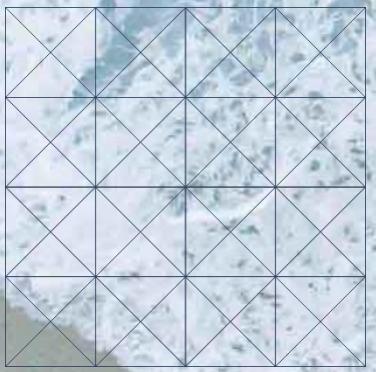
SECURED POSITIONS FOR FUTURE GROWTH

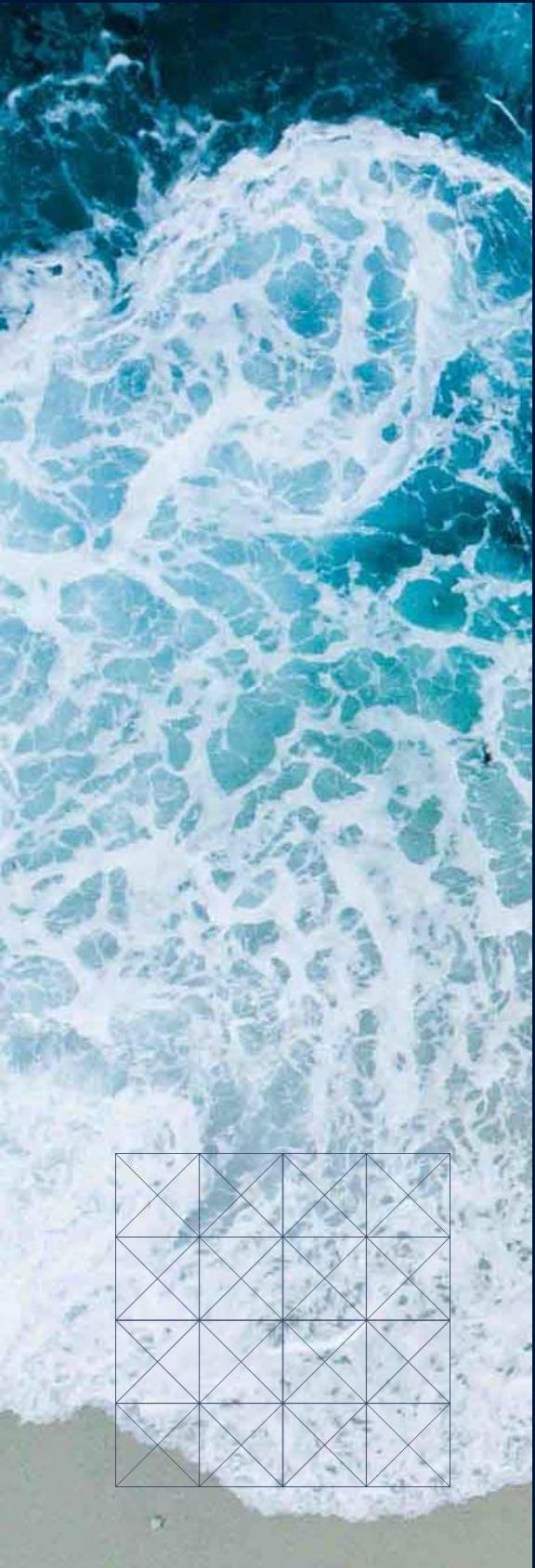




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Thank you





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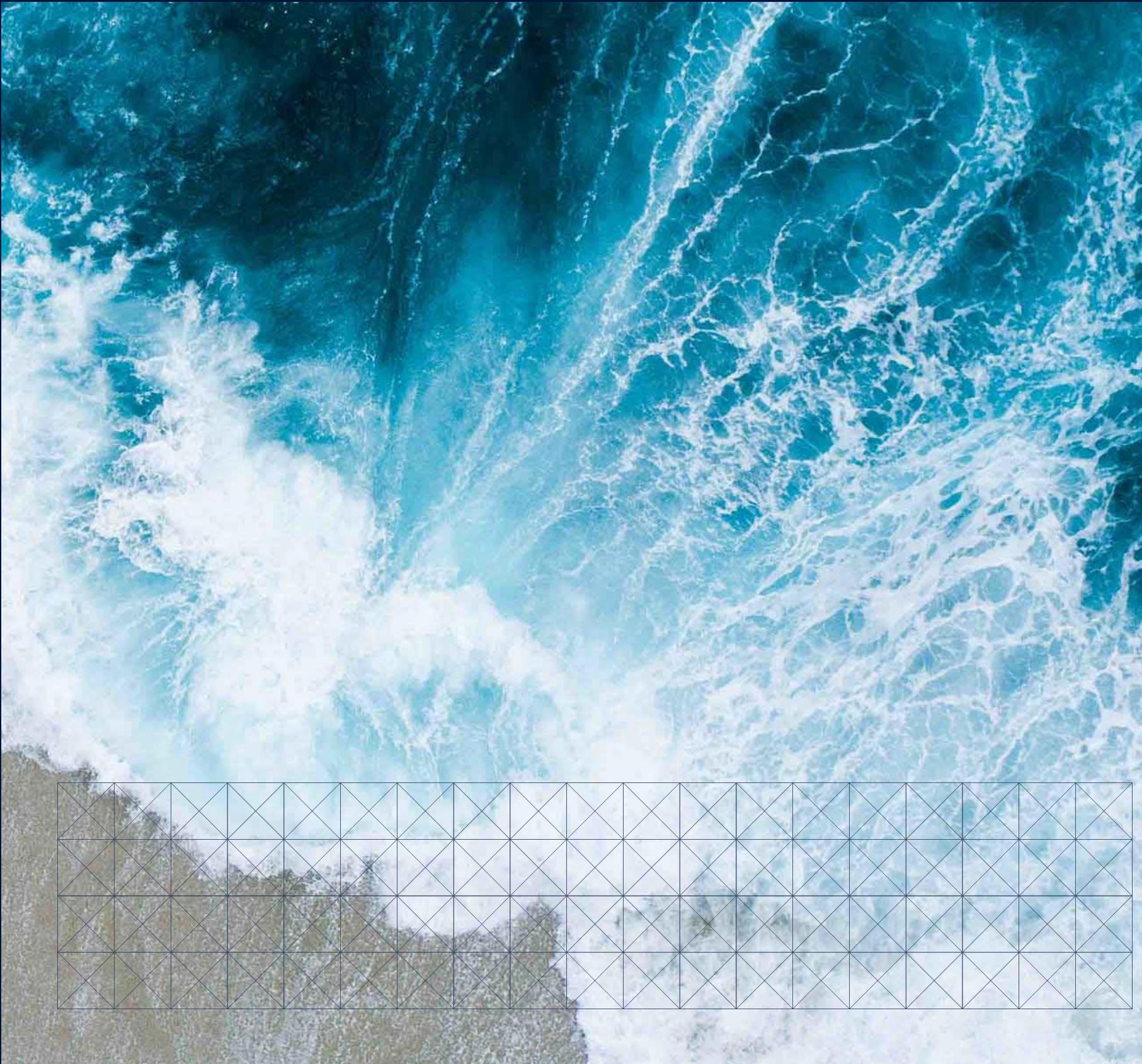
KONGSBERG MARITIME

Shaping the maritime future

26/10/2018

EGIL HAUGSDAL

PRESIDENT, KONGSBERG MARITIME





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KONGSBERG MARITIME

An ocean of opportunities

Offshore,
Merchant Marine, Subsea
and Emerging Business

Dynamic positioning, navigation,
automation, engineering, subsea and
seismic instrumentation,
marine robotics, sustainable fisheries,
handling and
energy solutions

World-wide
operations

More than 3,700 employees

Revenues LTM 7.4 BNOK

Order backlog 6.0 BNOK

Installed base more
than 18,000 vessels

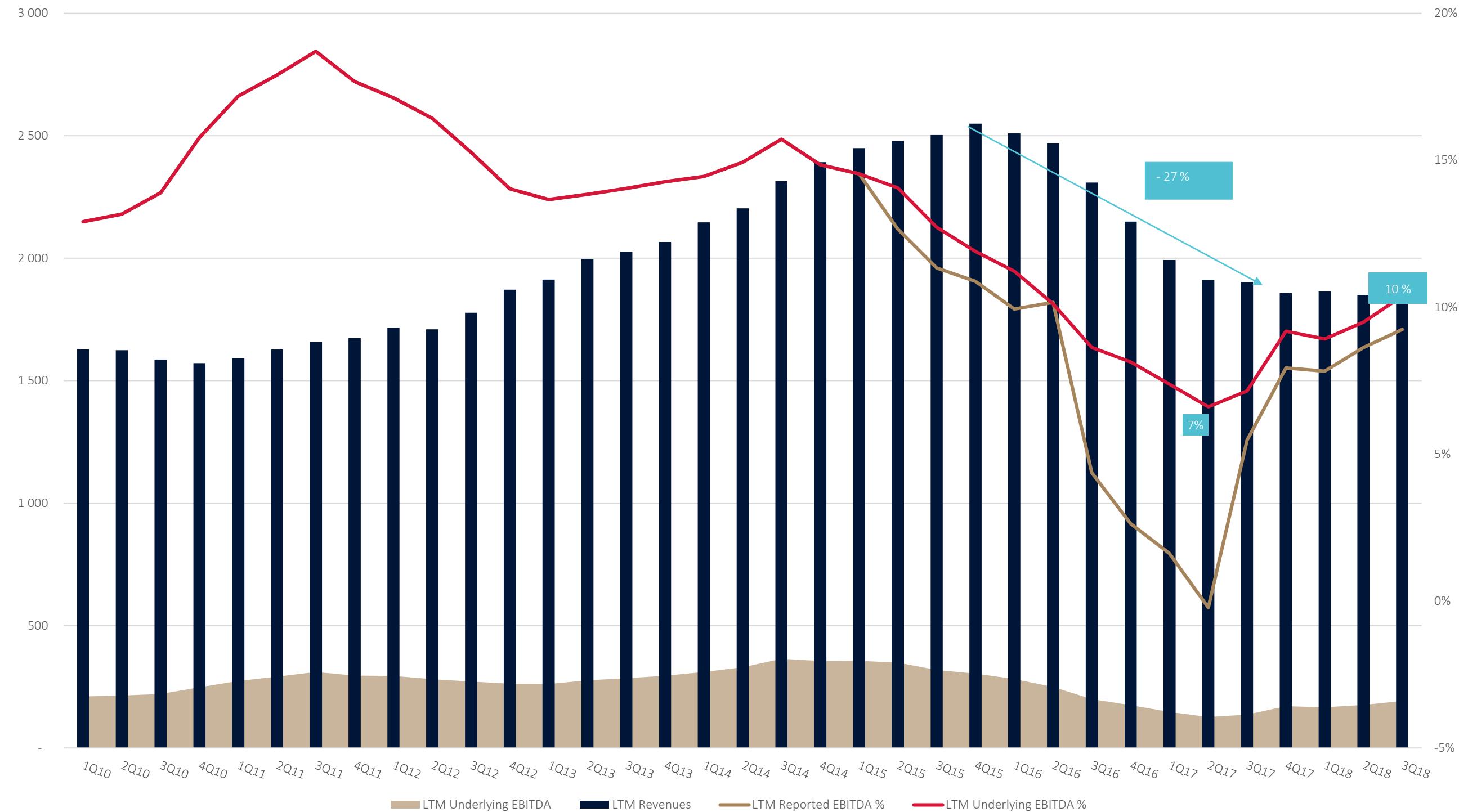




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We are navigating through extreme conditions...

...margins gradually more influenced by single-contract-impact





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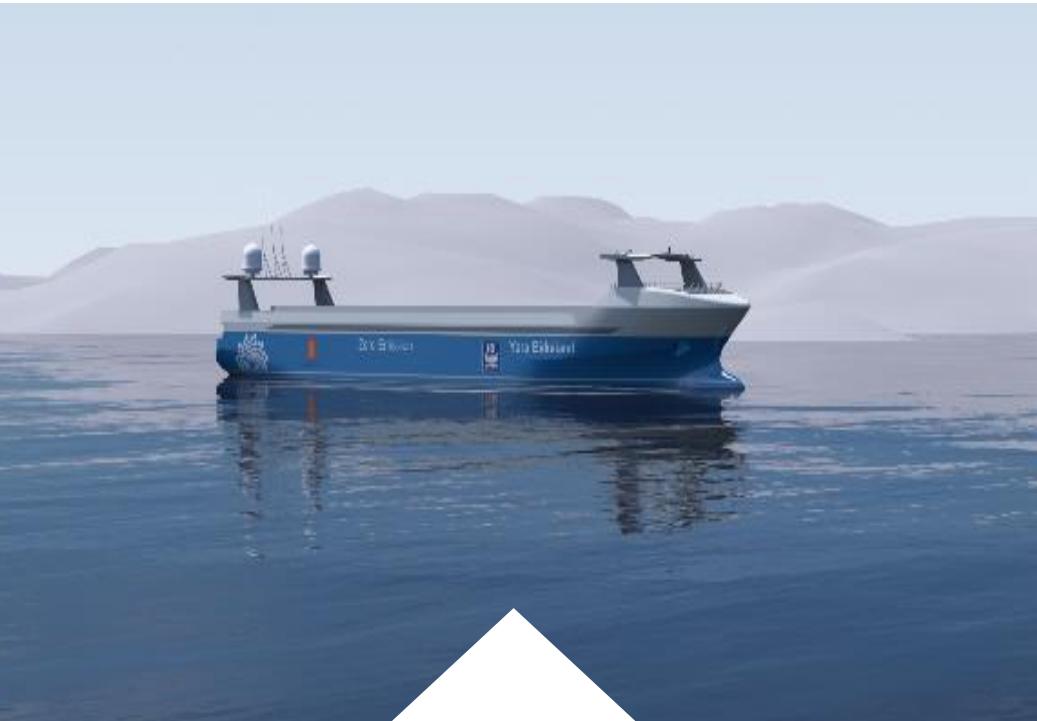
Adapting, Delivering & Positioning



Adapting to changing
markets



Delivering operational
excellence

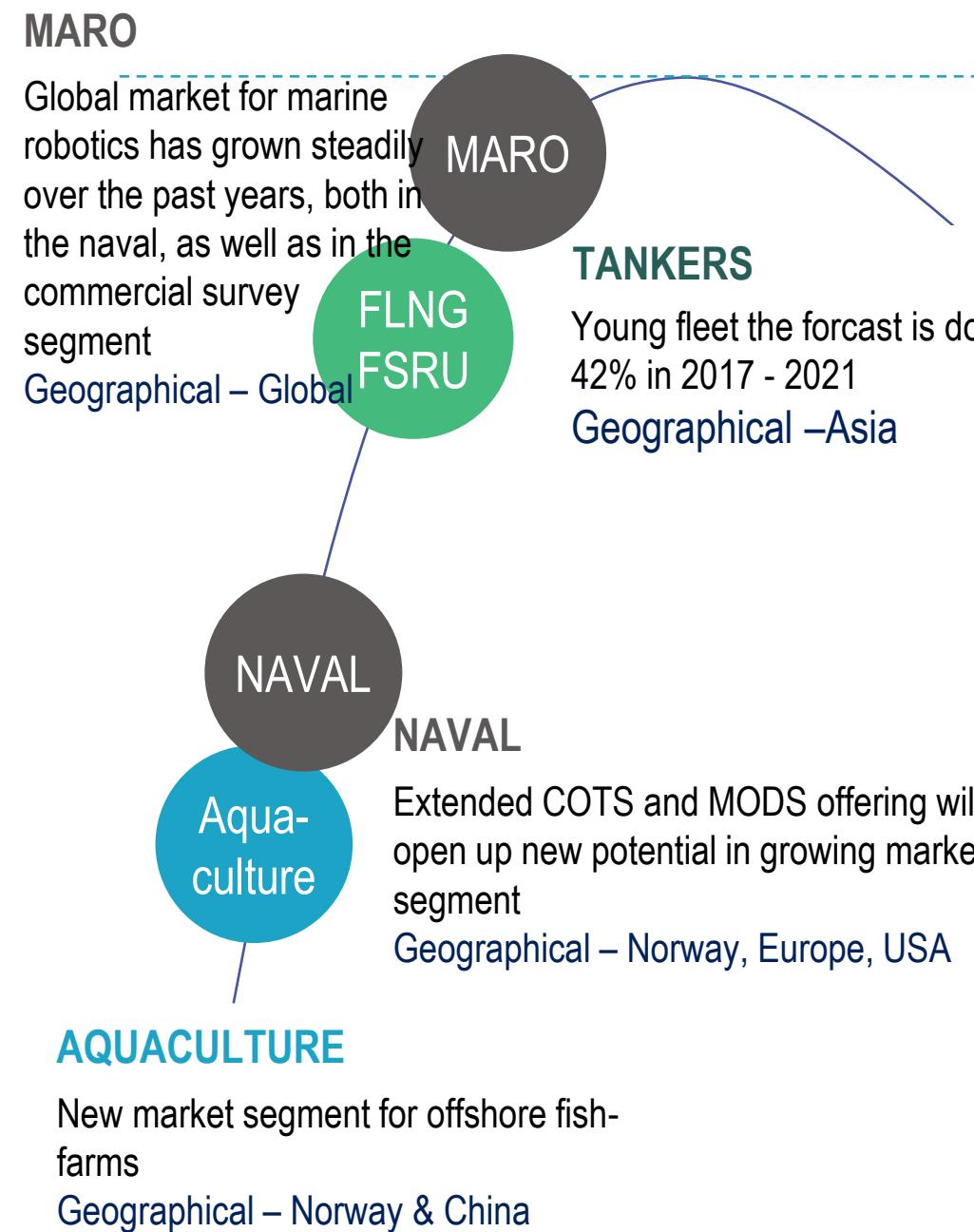


Positioning for future
markets



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Targeting opportunities in cyclic industries



FISHERY

Largely localized market and traditional in technology development;
Geographical – Europe

Fishery

RESEARCH

New-build activity expanded to incl. global market
South Africa, USA, Taiwan, China

Research

TANKERS

Young fleet the forecast is down 42% in 2017 - 2021
Geographical – Asia

Crude Tankers

CONTAINER

The container vessels are going from big vessels to ultra-big vessels combined with smaller container feeders
Geographical – Asia

Product Tankers

Wind

Container

Chem Tankers

LNGC

BULK

Dry bulk seaborne trade forecast to 3.4% annually in the next 10 years.
Geographical – Asia

Bulk

OPU

Driven with leased FPSO and
Oil major production units
Geographical – Europe, Brazil, West Africa & Asia

Merchant

Offshore

OPU

LNGC / FLNG / FSRU

Increased liquefaction trains coming onstream, driving mid stream (LNGC) & down stream (FSRU – LNG Small Scale bunkers)
Geographical – Asia & Middle East

OFFSHORE WIND ENERGY

Overall industry growth expected at 10-15% CAGR for purpose built SOV's for windfarm maintenance.
Geographical - Europe

PAX (CRUISE, FERRIES)

Ordering is expected to be at good levels due to increased passenger volumes
Geographical – Europe & Asia

A perfect fit

KONGSBERG + Rolls-Royce Commercial Marine



