Paulina Hobbs UK&I, Head of Operations East Coast, Lowestoft 29th of September 2015

New Course for Offshore O&M

O&M Offshore Market – History and Future

1. Where is the Offshore O&M Market Going?
2. Challenges of offshore O&M Today
3. Way forward: Keys to unlock the complex O&M situation

Siemens Wind Power: Pioneering in Offshore Wind Power and O&M Solutions

World‘s 1st offshore project **1991**

Vindeby

5 MW

World‘s 1st project with MW turbines **2000**

Middelgrunden

40 MW

World‘s largest project in operation **2013**

London Array

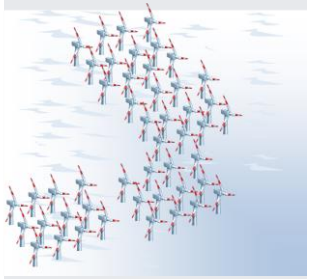
630 MW

World’s 1st large project w. 6 MW turbines **2014**

Westermost Rough

210 MW

World’s most complex far shore site **2016**



Gemini

600 MW

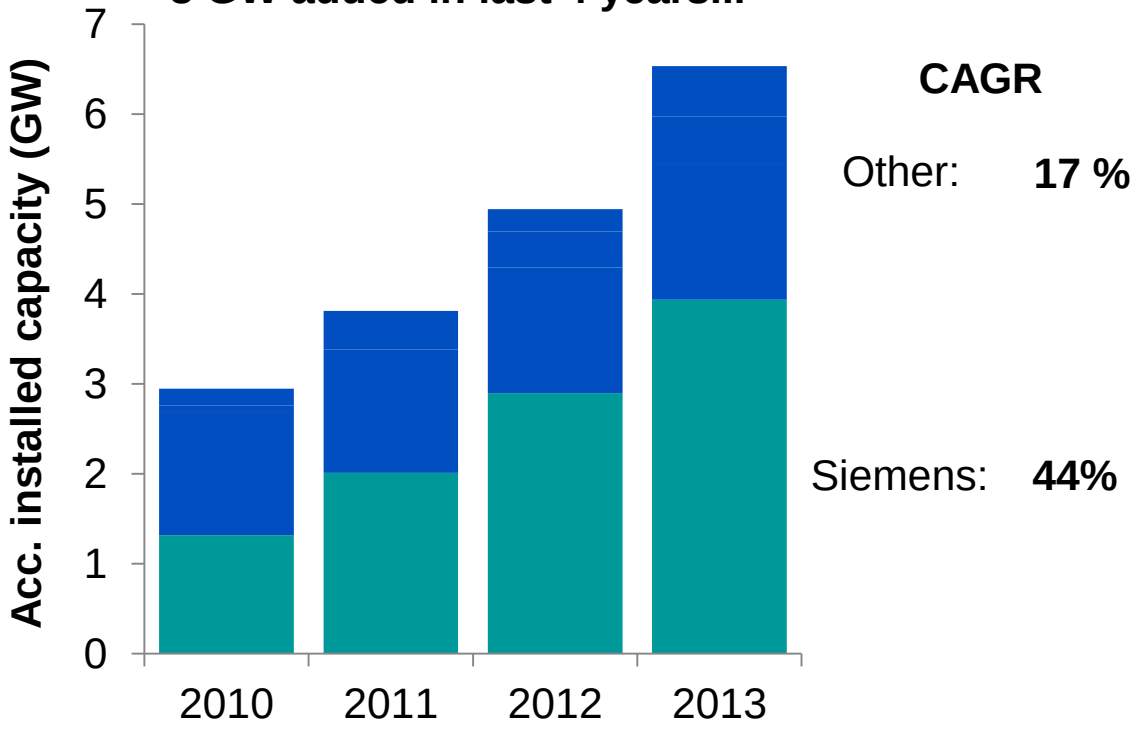
Offshore market leader with +3,5 GW installed in 20 projects over the last 5 years

Proven operational experience based on +1 200 offshore turbines since 1991

Pioneering solutions with trusted and recognized bankability

Offshore Wind Power: Strong Historic Growth

+3 GW added in last 4 years...

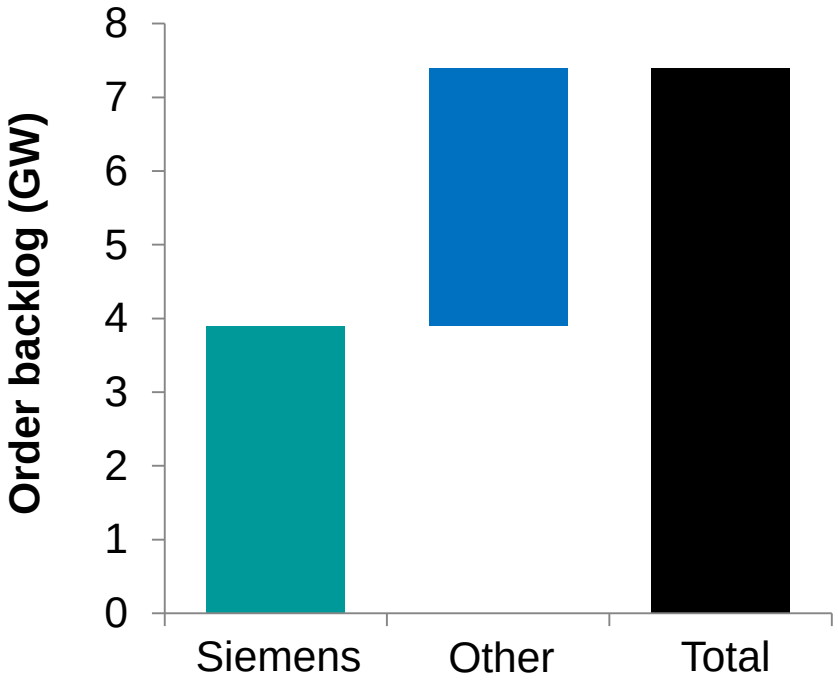


CAGR

Other: **17 %**

Siemens: **44%**

...further +7 GWs to come in next 4 years



Source:
EWEA: ”Key Trends & Statistics”

Source:
MAKE Consulting: ”Tough times lay ahead for tier 2 offshore OEMs”

Challenge: Securing Uptime More Important Than Ever

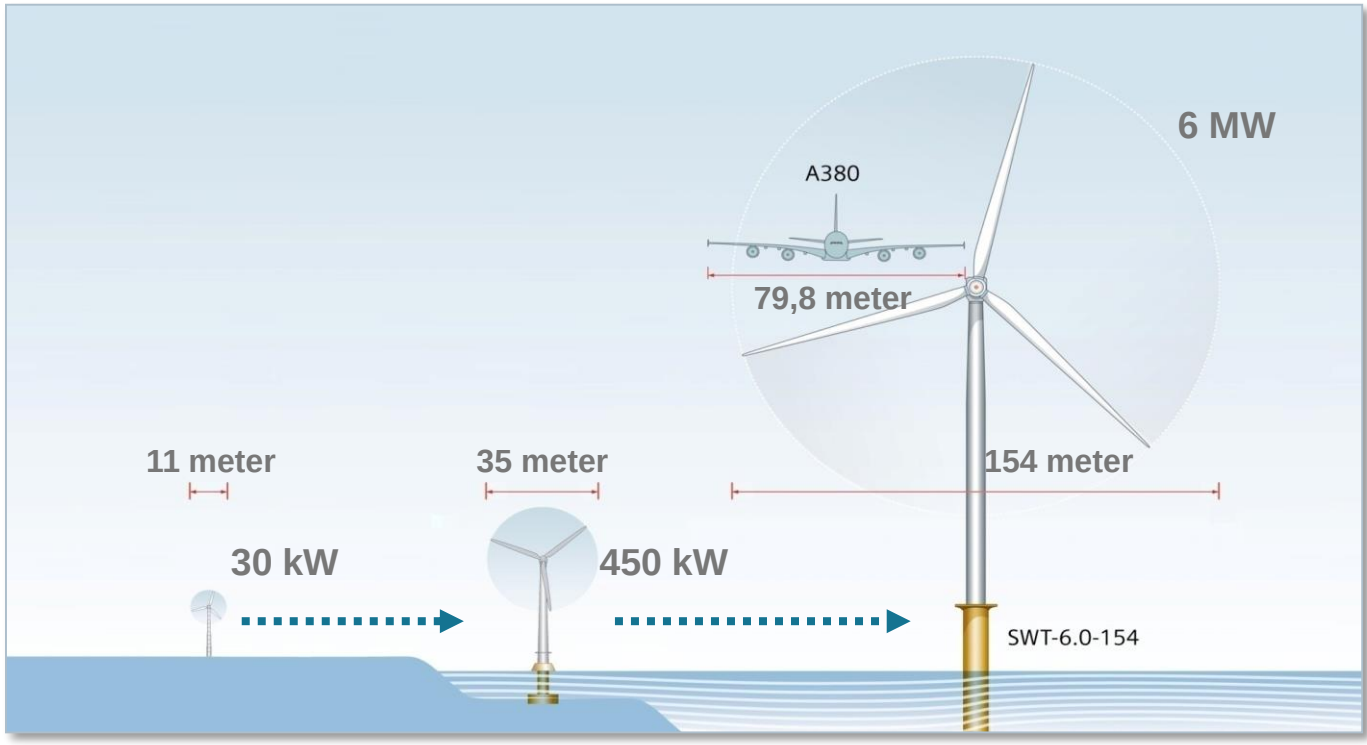
Dimensions of offshore technology

- Turbine size: From 450 kW to 6 MW
- Project size: From 5 MW to 630 MW
- Rotor diameter: From 35 m to 154m
- Hub height: From 35m to 120m
- Blade lift operations from 3 to 100 tons
- Introduction of DD technology

Cost of downtime:

Example of avg. production loss from 1 day of downtime for a North Sea offshore turbine

- 450kW turbine: EUR 250,-
- 6 MW turbine: EUR 4 000,-



Based on German FIT and 10m/s.

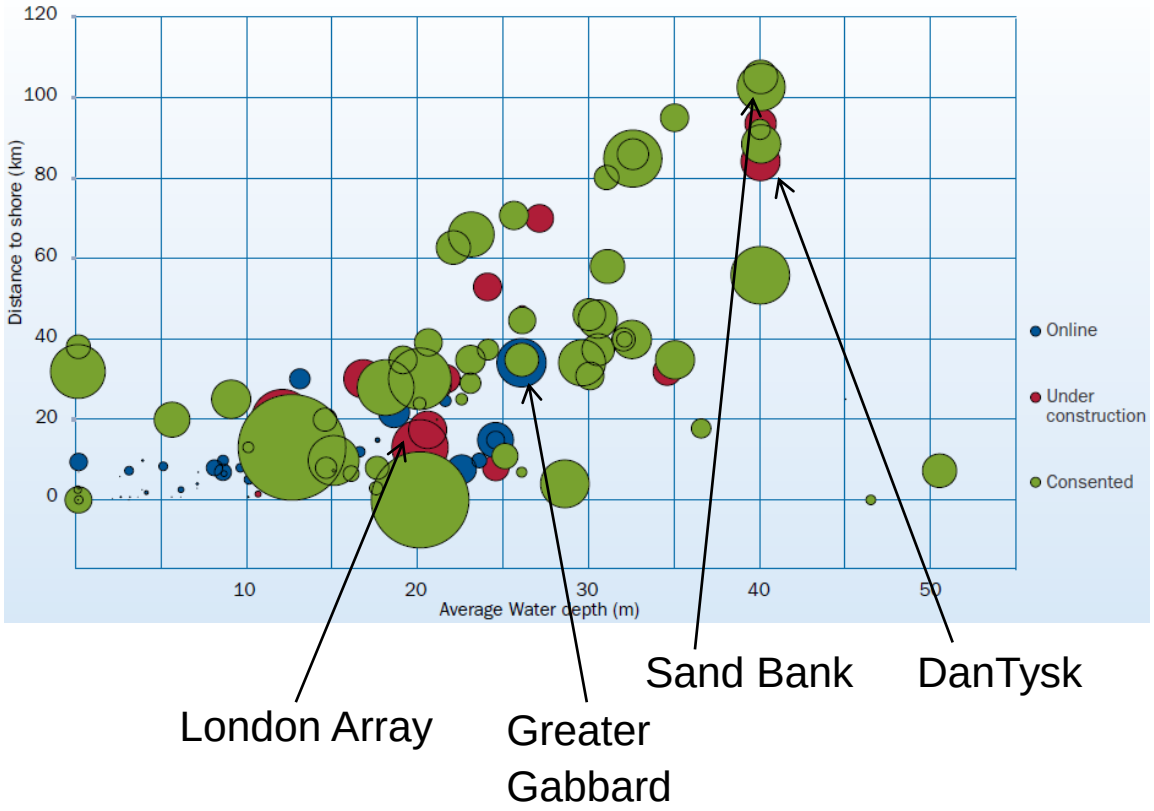
Challenge: Larger Projects Moving Far Shore into Deeper Waters

Crowne Estate estimates that in 2025 UK will have:

- 2 700 turbines within 12 NM => Traditional CTVs
- 3 800 turbines within 40 NM => 3rd generation CTVs
- 3 000 turbines beyond 40 NM => Far shore solutions

Based on traditional logistical solutions far shore wind power projects mean less efficient projects:

- Extended and uncomfortable travel time
- Smaller available window for O&M operations



Source:
EWEA: "Key Trends & Statistics"

Challenge: Have Traditional Access Solutions Reached Their Limit?

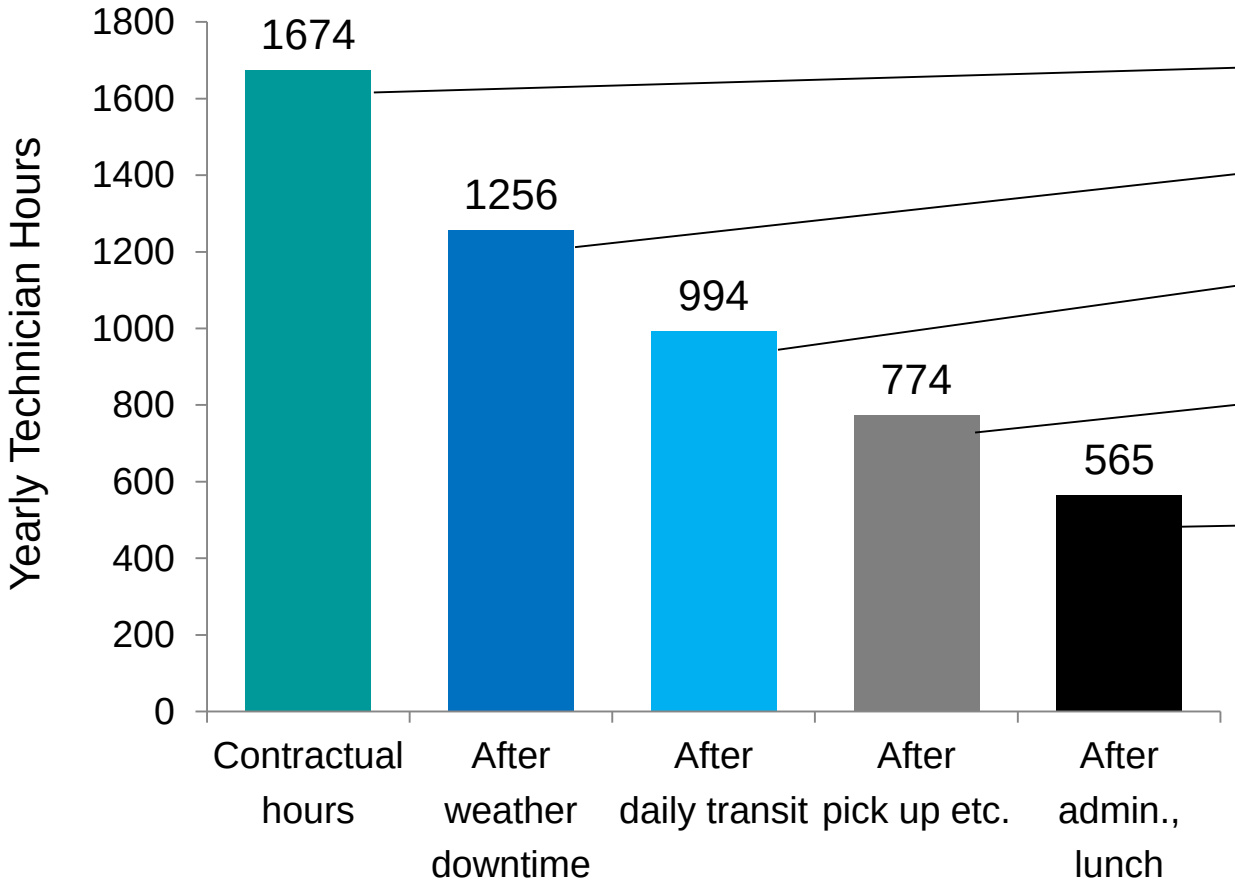
- **Travel time**
  In large projects the wasted transit time using several CTVs can exceed the window of effective working hours in the turbine

- **Travel comfort**
  The human body absorbs motions from the sea – even when sailing at 1.5 m Hs. (Hmax can be up to 1.5 – 1.8 times higher)

- **Limited planeability of production**
  Fender access is subject to the individual perception and well-being of offshore technicians

Challenge: We end up working less than 1/3 of the time

Reduction of daily working hours



Reasons why we end up not working:

- Yearly available working hours per technician
- 25% weather downtime
- Transit time 1 hour 15 min each way
- Waiting time in the wind farm – pick up
- Briefings, EHS instructions, lunch and other private time

We need to reduce wasted time:

- Work more effectively
- Fix basics remotely

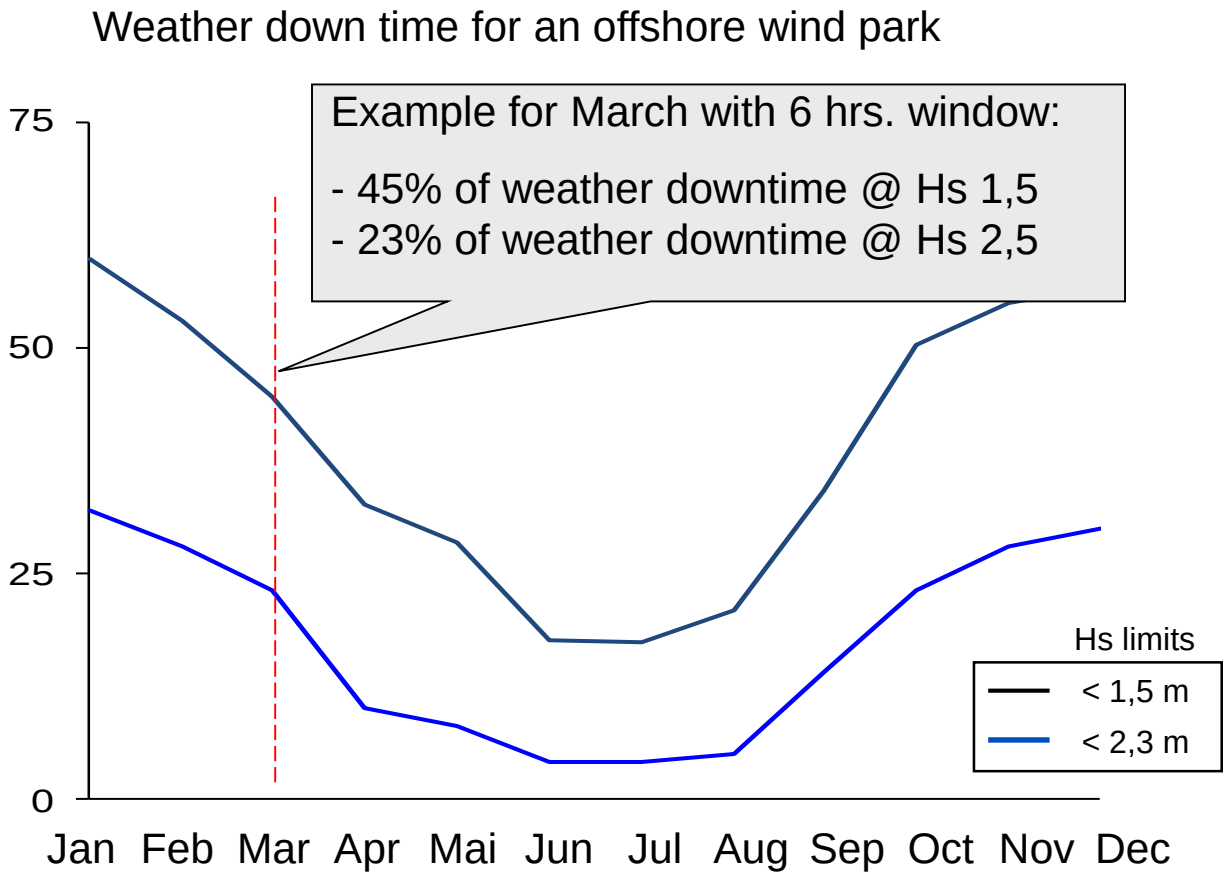
Challenge: When Access is needed, it is most difficult

Seasoned scheduled services ?

Winter time is great for wind power yield,
but work against us when we have to fix failures

We need to be able to access especially when the potential loss of production is highest,
but this is not always possible due to high waves and small vessels

Access is key – throughout the year!



O&M needs to take a New Course:
5 Keys to unlock far shore O&M Complexity

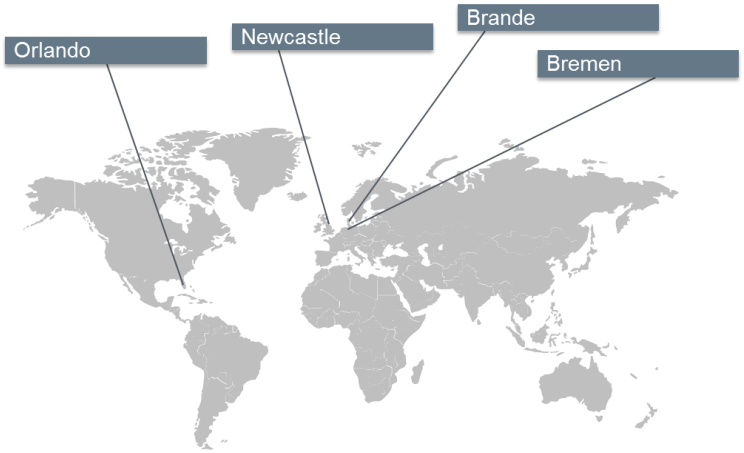
Match complex high growth scenario with the right solutions:

1. Integrate EHS right from the start in every solution – too many errors in the industry currently
2. Utilize Smart Data:
   Remote monitoring and diagnostics
3. Simulate and model logistic service concepts before operation: ”Think before acting”
4. Rethink logistics towards purpose built vessels and new access methods
5. Change O&M perception:
   From: *Visiting a wind farm* for O&M purposes
   Into *Living in the wind farm* for O&M purposes

Key no.1:
Integrating EHS from the Start: Safety by Design

Preparing employees:

- Global technical courses and safety trainings
- Active member of Global Wind Organization
- 1 600 technicians have obtained qualification to service Siemens turbines



Planning the O&M operation:

- Modelling and simulation of service logistics
- RDA – fix failures remotely, bring the right parts

Execution with Zero Harm:

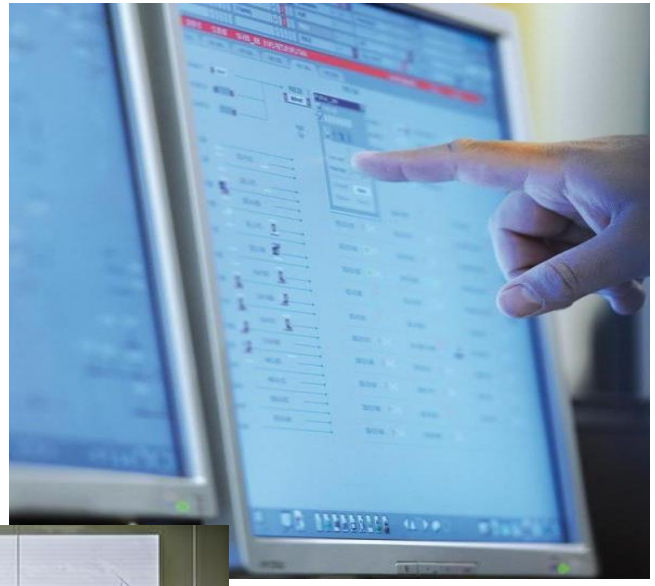
- Roll with the waves for hours or walk to work from a comfortable and efficient vessel

Key no. 2:
Utilize Smart Data: Avoid visits

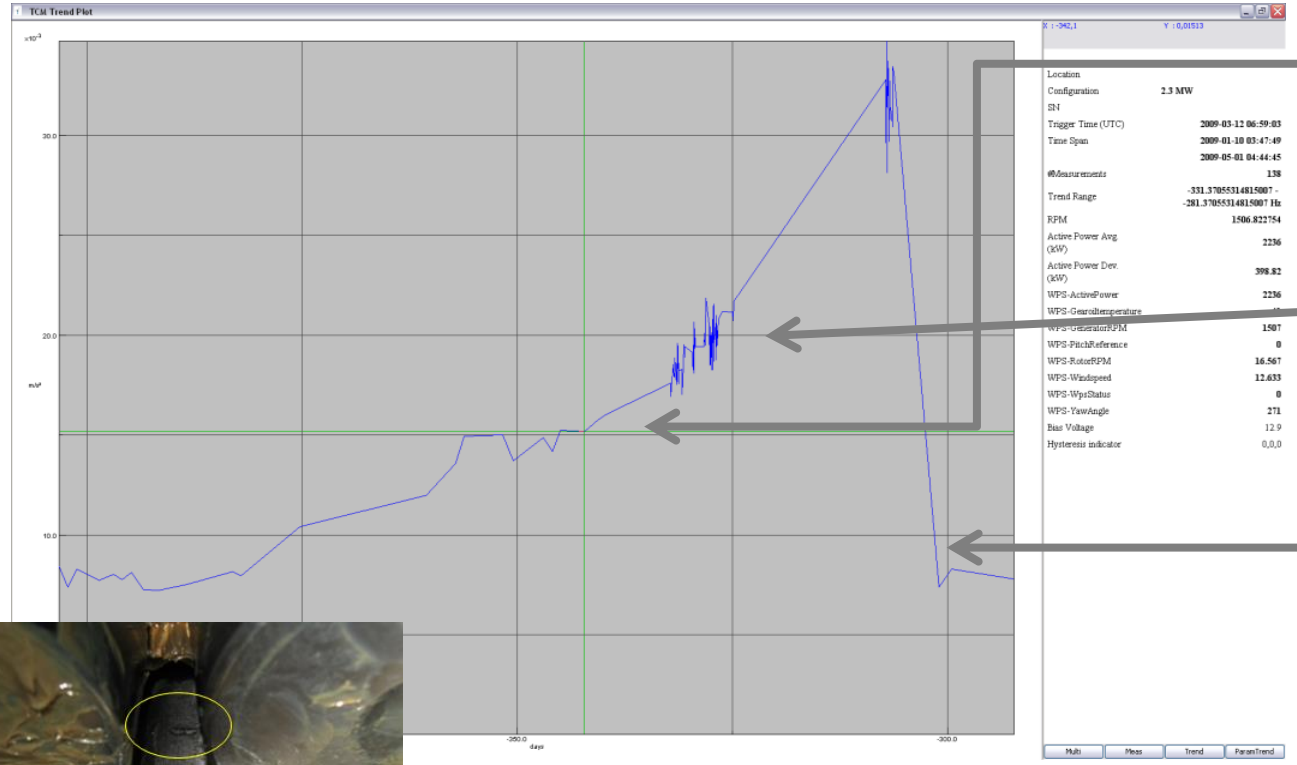
Fix the basics remotely
- Minimize events where corrective service operation and call out of technicians is needed.

Turn unplanned into planned service
- Early identification of fast and slowly developing failures
- Optimized planning of service, spare parts and chartering of vessels

Vibration diagnostics
- High resolution data analysis on complex issues



Key no. 2
Utilize Smart Data: Plan efficiently



1) Inspection request when vibration level reach mask maximum.

2) Visual inspection in the WTG 13 days later to find there is a damage to the main bearing

3) 4 weeks from visually inspecting the damage, the main bearing is exchanged and vibration levels become normal again.

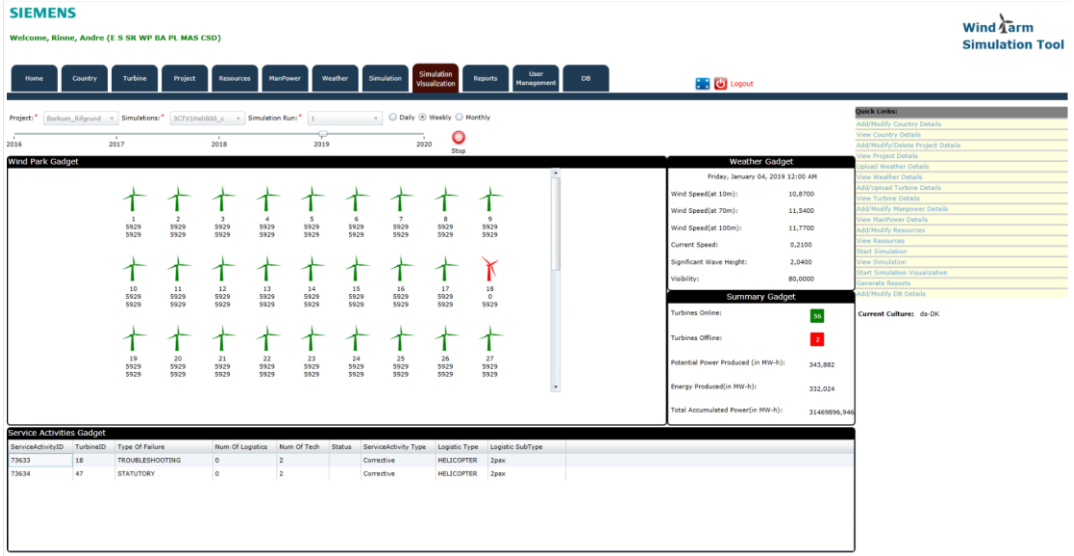
The turbine was monitored closely, but kept in operation due to the early detection – with efficient mobilization of a jack up and sourcing of components.

Key no. 3:
Simulation and Modelling before Operations

Modelling Input

- Weather data
- Turbine data
- Service terms
- Technicians
- Project and site specific data
- Logistical asset specifications

Wind farm simulation and risk assessments



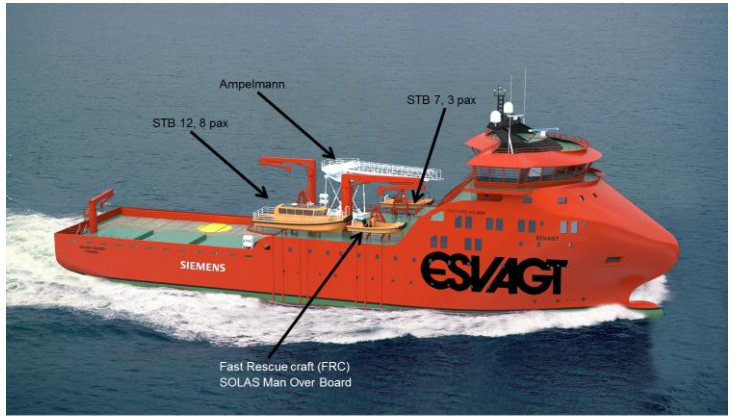
Output scenarios

6 CTV solution:
+ Cheap vessel
- Many technicians
- Too much wasted time

SOV, CTV and heli solution:
Efficient

2 SOV solution:
+ EHS
- Many technicians
- Too much wasted time

Key no. 4:
Rethink Logisitics: Pioneering a New Vessel Design



New design conceived: Service Operation Vessel

Dec 2014: On schedule for delivery

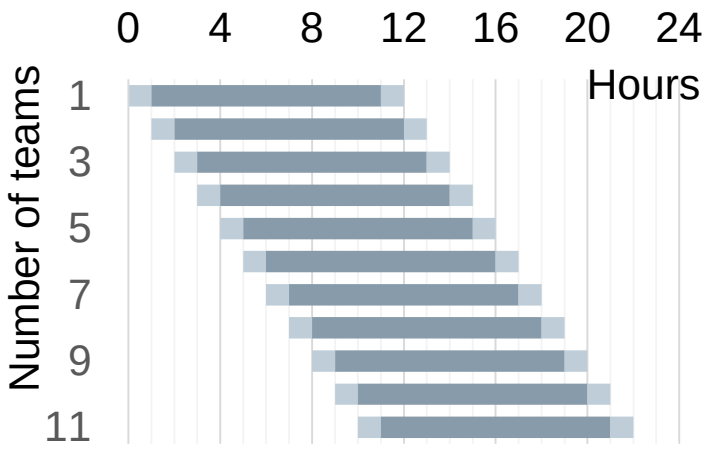
2 additional SOVs ordered for DanTysk / Sandbank and Gemini

Pioneering a new vessel class: Service operation vessel (SOV):

- Reducing weather downtime with operations in 2.3m Hs waveheight
- Hydraulic gangway access and modern crew accomodation
- Spare part storage and daughter crafts for in-farm operations

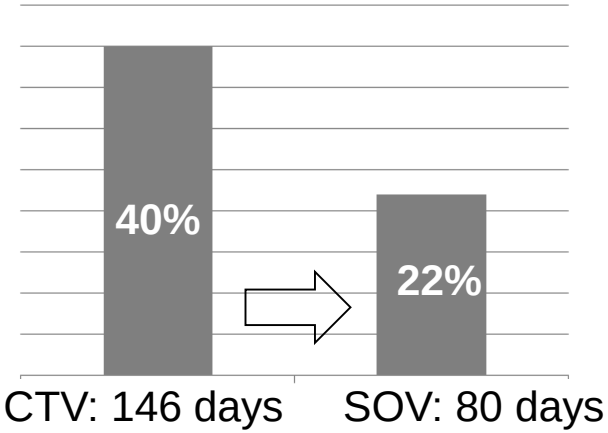
Key no. 4
Rethink Logisitics: Advantages Employing SOVs

Example: Staggered shift pattern



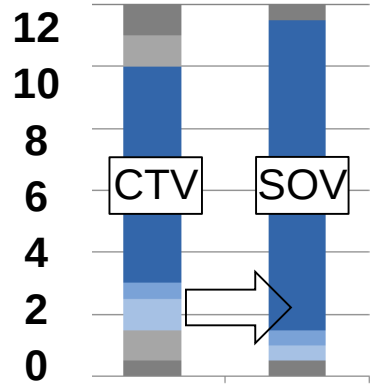
One vessel to deploy several teams

Example: Weather downtime comparison for an offshore site



One vessel to reduce weather dowtime

Example: Effective working hours for a technician in a 12 hours shift



One vessel to reduce waste time

Implications of employing a Service Operation Vessels for Large Far Shore Projects:

- Staggered shift pattern to reduce waste time during shifts
- From 1.5 m Hs to 2.3m Hs waveheight to reduce weather downtime and staff
- Living in the wind farm reduces time wasted and increases efficiency of offshore O&M

Key no. 4
Rethink Logisitics: Pioneering in Dedicated Service Jack-Up


New service jack up design by DBB


DBB service jack up under construction


Siemens' long term charter of WIND SERVER

Advantages of chartered purpose built vessel

- Dedicated service of large-scaled offshore projects across Northern Europe
- Purpose-built with smaller dimensions for flexible and fast O&M operations
- Reduced mobilization and a well trained crew, will secure fast responses to unscheduled events

Photos: Courtesy of DBB JackUp A/S

Key No. 5
Change of Perception - The Gemini Project

SIEMENS

Project specifications:

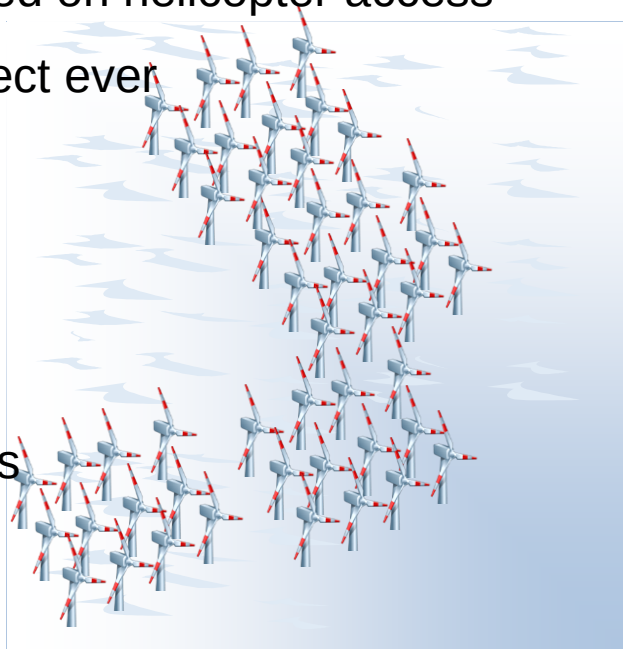
- 80 km from shore and 68 square km
- 150 turbines: SWT 4.0-130
- 15 year LTP service term from 2016
- Two-contract structure:
  Turbine contract and BoP
  - minimized interface issues and easier financing
- OEM participation in financing

What's new ?

- First far shore site using the SOV and helicopter for O&M
- SOV operation in staggered shift pattern – 14 days shift
- First to integrate helicopter access and heli pad inside the wind farm
- First Dutch O&M operation based on helicopter access
- Biggest and most complex project ever

From: ***Visiting a wind farm for service*** purposes

Into: ***Living in the wind farm for service*** purposes



Thank you for listening

Paulina Hobbs
Siemens Power Services – Wind Power
Head of Operations East Coast UK&I

Contact Information
paulina.hobbs@siemens.com

Mobile: +44 7921243033