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</tr>
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<td>“Går-hjem” meeting</td>
</tr>
</tbody>
</table>
Opening and welcome
1. Meeting opening, welcome, and agenda review during working lunch
2. New/changed Reference Group member organizations / changed participants – short introduction by new participants
3. Review of scoping of PhD research project efforts from first meetings
4. Key activities since last meeting. Focus on:
   a) The “speed boats” from the PhD “mother vessel”
   b) Government relations and tailor-made grants (Horizon 2020)
   c) Concurrent dissemination of research results and findings
5. Workshop on shipping/logistics/SCM/transport innovation and R+D within global wind energy with a special focus on offshore wind – the tail that wags the dog?
6. Update on academic progress, 11-month plan, and plans going forward
7. Wrap-up, preparation for “gå-hjem” meeting, and date/venue for next meeting
Brief introductions
(organizations, participants)
Intro to new/changed Reference Group participants

• Quick personal background
• Brief overview of the activities of your organization
• Expectations from participation in the Reference Group and research project
Today’s program

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Scoping from first meetings
End-to-end life-cycle focus

Two different flows: Onshore and Offshore

Development and consent phase
Installation & commissioning phase
Operations & maintenance phase
De-commissioning phase

Source: LogMS conference paper, 2013, Singapore 2013, Poulsen et.al.
Shipping, logistics, SCM, end-to-end: What does it really mean?

**Conclusion:**
“The inbound to manufacturing assembly supply chain consists of “standard transportation” mainly by ocean and some air. This part of the end-to-end supply chain was therefore considered less interesting for the project to review than installation & commissioning, operations & maintenance, and decommissioning”

<table>
<thead>
<tr>
<th>Theory / Practice linkage</th>
<th>Support / Lobby</th>
<th>Challenges /Solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learn biz</td>
<td>Convey info</td>
<td>Practical and relevant / correct</td>
</tr>
<tr>
<td>Chinese market network sharing</td>
<td>Investments going forward (vessels, financing, etc.)</td>
<td>Practical background → tools</td>
</tr>
<tr>
<td>Reducing LCoE</td>
<td>Project timelines</td>
<td>Academia vs. consulting</td>
</tr>
<tr>
<td>Applied research</td>
<td>Offshore wind knowledge</td>
<td>Capture change</td>
</tr>
<tr>
<td>Good quality research</td>
<td>Case studies</td>
<td>Look at change in future</td>
</tr>
<tr>
<td><strong>Scope:</strong> Narrow, realistic, big, complex, crystalize, etc.</td>
<td>Continuous “smart” goals: Concrete, specific, look ahead, value</td>
<td>Moving research target (in time)</td>
</tr>
<tr>
<td>On-time project</td>
<td>E2E wind supply chain</td>
<td>Bridge more industries</td>
</tr>
</tbody>
</table>

Source: First Reference Group meeting

Department of Mechanical and Manufacturing Engineering - Shipping & Logistics

Aalborg University
Denmark
Case study efforts

Number of companies

Time spent

Extent of case study scope

Depth

Width

Europe

Asia

Americas

Offshore, simple and easy cases

Offshore, one case

Onshore, rail focus
Wind energy shipping and logistics: Involved parties...

Freight forwarders:
- Global
- Regional
- Local

Ocean transportation and related:
- RO/RO (“Roll-on/Roll-off”)
- LoLo (“Lift-on/Lift-off”)
- Short-sea/regional operators
- Tug/barges and landing crafts (“LCTs”)
- Multi-purpose vessels (“MPV”) / Floating cranes
- Container vessel operators
- Safety vessels, work boats, and crew/hotel vessels
- Special vessels like offshore wind turbine installation and cable laying vessels

Ports | Storage: 
- Warehouses
- Yards
- Storage areas

Rail | Specialty trucks

Land based cranes

Utilities | Operators | OEM’s | EPC companies | SWF

Extent of services

Source: LogMS conference paper, 2013, Singapore 2013, Poulsen et.al.
Definition of “The blue Denmark”

**Conclusion:**
“Definition should be rather broad for this project and not just include for example the shipping companies/DSA members”
Onshore and offshore SCM
Onshore and offshore wind – Differences and similarities

Conclusion:
“Whereas both similarities and differences exist between the onshore and offshore wind farm supply chains, the offshore wind supply chain is more complex in terms of shipping and logistics”

<table>
<thead>
<tr>
<th>Similarities</th>
<th>Differences</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inland:</strong></td>
<td><strong>Sea carriage:</strong></td>
</tr>
<tr>
<td>- Same trucks / Equipment</td>
<td>- Assembly to site (outbound)</td>
</tr>
<tr>
<td>- Daytime</td>
<td></td>
</tr>
<tr>
<td>- Infrastructure</td>
<td></td>
</tr>
<tr>
<td><strong>Port storage:</strong></td>
<td><strong>Infrastructure:</strong></td>
</tr>
<tr>
<td>- Temp. storage</td>
<td>- Quayside loading / logistics</td>
</tr>
<tr>
<td></td>
<td>- Diff. equipment (vertical)</td>
</tr>
<tr>
<td></td>
<td>- Area / space (buffer)</td>
</tr>
<tr>
<td></td>
<td>- Seamen education (outbound)</td>
</tr>
<tr>
<td></td>
<td>- BOP</td>
</tr>
<tr>
<td></td>
<td>- Installation / equipment / skills</td>
</tr>
<tr>
<td><strong>Actual maintenance</strong></td>
<td><strong>Maintenance</strong></td>
</tr>
<tr>
<td></td>
<td>- Certificates</td>
</tr>
<tr>
<td></td>
<td>- Transportation</td>
</tr>
<tr>
<td></td>
<td>- Equipment</td>
</tr>
</tbody>
</table>

Source: First Reference Group meeting
## Scoping of the Ph.d. research

### First Reference Group meeting scoping conclusion:

<table>
<thead>
<tr>
<th>Wind farm phase</th>
<th>Development &amp; Consent (D&amp;C)</th>
<th>Installation &amp; Commissioning (I&amp;C)</th>
<th>Operations &amp; Maintenance (O&amp;M)</th>
<th>De-commissioning (De-comm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply chains</td>
<td>D&amp;C chain</td>
<td>I&amp;C chain - Inbound</td>
<td>O&amp;M - Preventive</td>
<td>De-comm chain</td>
</tr>
<tr>
<td>Description</td>
<td>Site surveys, birds, wildlife, sea, seabed</td>
<td>Inbound assembly parts and components</td>
<td>Personnel, parts, and components</td>
<td>Restoration of site for new wind farm or to original condition</td>
</tr>
<tr>
<td>Characteristics</td>
<td>Specialized vehicles (onshore) and vessels (offshore)</td>
<td>Mainly a homogenous flow using ocean containers and air; some project cargo</td>
<td>Project cargo/break-bulk</td>
<td>Project cargo/break-bulk</td>
</tr>
</tbody>
</table>

- **Assumed to have the largest possible impact on potential reductions of levelized cost of energy**

Source: Brand new research to be published soon. Watch this space!
Achievements since last meeting
Offshoreenergy.dk “Cost Reduction Forum”, part II

• Start-up of logistics O&M project
• Funnel approach
  ✓ Sub-projects for top 3 ideas for lowering LCoE
• Student exam with grade 10
• September 17, 2015 summary
DONG Energy Wind Power logistics R&D RM5 Logistics strategy project, part II

- Transcription of 15 interviews
- Pilot survey to 15 respondents
- Main survey to 100 respondents
  - Analysis of all findings
- 4 student exams, all with grade 10
- Final strategy submission July 22
  - Reference Group review September 7
Speed boats - ongoing

Offshoreenergy.dk “Cost Reduction Forum”, part III
- Focus on Logistics O&M work stream

Offshoreenergy.dk “Cost Reduction Forum”
- End-to-end logistics process

Offshoreenergy.dk China BSR project

Liftra
- China market entry project

Siemens Wind Power
- Various project proposals (buying terms, site parts, RO/RO)

Vestas
- Logistics strategy dialogue initiated
EU argument: Derived market

Government induced demand

Wind industry

Firm functions

- Engineering
- R+D
- Sales
- Marketing
- Accounting
- HR
- Financial
- Sourcing
- Shipping/logistics
- Operations

Derived support industry

GLOBAL WIND ENERGY SHIPPING AND LOGISTICS
AALBORG UNIVERSITY
EU Commission H2020 WP Energy 2016-2017 lobbying status:

- Logistics and shipping text successfully inserted
- 2 separate low carbon energy calls about wind energy
  - **LCE 13 – 2016**: Solutions for reduced maintenance, increased reliability and extended life-time of wind turbines/farms (grant size **EUR 7-10 million**)
  - **LCE 14 – 2017**: Demonstration of large >10MW wind turbine (grant size **EUR 20-25 million**)

**Huge success!**
Government relations - DMD

Energy & Transport Summit, October 9, 2015, Copenhagen, Danish Maritime Days

• Mid-term PhD seminar
  ✓ Thomas Poulsen
  ✓ 45 minutes

• Panel session (90 minutes)
  ✓ 1 moderator
  ✓ 5 speakers
    ➢ Politics
    ➢ Risk management
    ➢ HSE
Government relations - ongoing

Test site lobbying with Rønne Havn:
1. Small scale test – DTU, Force
2. Shore turbines – Østerild
3. Other parts – LORC

Next up:
In the ocean?

MEGAVIND
Academic

- NEDSI conference, Boston, March, 2015
- EIASM M&A PhD course, Brussels, March, 2015
- Peer reviewed book chapter published (Pearson) May, 2015
- OEDK BSR China fact-finding trip, July, 2015

Industry

- DHL conference, Copenhagen, March, 2015
- Cost reduction forum, Jutland, spring, 2015
- Short Sea Shipping 2015 conference, CBS, Copenhagen, June, 2015
- MSSM conference, Nyborg, August, 2015
## Planned dissemination

### Academic
- Journal paper about readiness of green supply chain, November, 2015
- Journal paper about O&M logistics OEDK CRF case, August, 2016

### Industry
- Gå-hjem meeting today
- Mid-term conference and panel on politics, risk, and HSE on October 9, 2015 at AAU CPH (in connection with Danish Maritime Days)
- OEDK BSR China delegation trip in October, 2015
- Next gå-hjem meeting in March, 2016
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Introduction of short workshop
OWF siting is crucial

1. Distance to shore
2. Water depth
3. Number of wind farm turbine positions
4. Weight and dimensions of WTG, foundation, and other BOP
5. Seabed conditions

- Near shore
- Offshore
- Far offshore
In Europe...

• Similar wind conditions:

➢ Horns Reef III

➢ Hornsea

Example of unique China offshore-inter-tidal wind farm outbound I&C challenges

Example Jiangsu Dafeng project (installation by Longyuan Zhenhua JV):
• 30 km from shore, Western part of farm will have riverbed exposed during low tide
• Eastern part of farm will need WTIV’s to be permanently jacked up out of the water
• Requires different kinds of vessels than in Europe

Source: NEA & World Bank (2010), BTM Consult part of Navigant & Poulsen (2012), and AAU research
The 6 MW (7 MW) SWP WTG
Foundations need to catch up...
The race is on for larger WTG output - and importance of shipping/logistics/SCM
About knowing one’s place

The tail does NOT wag the dog

We in transport know that we are basically considered coolies that just make things work...
Innovation – what comes first?

Transport industry always caught back-footed – need to get in front of industry R+D trends…

First WTG serial production 1979

3-4 MW

2 MW

1 MW

Onshore NOW

Offshore NOW

Prototypes several OEMs

5-6 MW

7-8 MW

10 MW

15 MW

20 MW

20+ MW

R+D GE USA

R+D 5-10 OEMs

R+D university + industry

Wind industry technology R+D leaps

Transport industry always caught back-footed – need to get in front of industry R+D trends…
## Wind R+D

### Weight & Dimensions

<table>
<thead>
<tr>
<th></th>
<th>Nacelle weight (t)</th>
<th>Blade Length (m)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Siemens 2.3 MW</td>
<td>82</td>
<td>45</td>
</tr>
<tr>
<td>Repower 6.15 MW</td>
<td>325</td>
<td>61</td>
</tr>
<tr>
<td>Siemens 6 MW</td>
<td>364</td>
<td>75</td>
</tr>
<tr>
<td>Samsung 7.5 MW</td>
<td>390</td>
<td>80</td>
</tr>
<tr>
<td>Vestas 8 MW</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Implications on:
- Transport equipment
- Assets
- HSSEQ

### Transport Equipment

Trucks, trains, roads, bridges, storage facilities, lifting equipment, ports, vessels…

### Makers of wind turbines (OEMs):

#### The pioneers

- Neg Micon®
- Siemens
- Vestas
- NASA

#### The “other” Europeans

- Enercon
- Nordex
- Gamesa
- Areva

#### Examples of the Asian “newcomers”

- Goldwind
- Suzlon
- Hyundai
- Samsung
- Unison

Source: AAU research, DHL Global Forwarding, Renewable Energy Solutions
Dimensions – Logistics challenges

Source: Danish Shipowners’ Association, courtesy Siemens Wind Power
2 Shortsea modes of transport

LoLo (MPP/HL)

2.3MW
2500
2456

3.6MW
500
1538

6.0MW
460
882

Hull Max
65
10
2

Standard Lo-Lo Tonnage
Standard Heavy-lift Tonnage
Special Heavy-lift Tonnage

(2014)

Source: Clarksons Shipping Intelligence, IHS Fairplay, and MDST Databank

RO/RO cargo

3,260 total

2.5 MW

4 MW

6 MW

(n. o. vessels)

0
500
1,000
1,500
2,000
2,500
3,000

RoPax
Vehicle Carriers
RoRo Cargo
Rail Vehicles
ConRo

Source: IHS Fairplay

Vessel size by lane metre capacity (No. of ships)

2006
2014

<1000 lane metres

>3000 lane metres

Source: Clarksons Shipping Intelligence, IHS Fairplay, and MDST Databank
RO/RO trends

<table>
<thead>
<tr>
<th>Ro-Ro Fleet</th>
<th>Free Height 6.5m</th>
<th>Free Height 10.5m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Ships</td>
<td>49</td>
<td>3</td>
</tr>
</tbody>
</table>

Source: Navitaship, Clarksons
And what about...

Floating turbines...

• Installation?
• O&M?
Groups on innovation
- technology vs logistics/shipping

Group #1  WTG

Group #2  Foundations

Group #3  Floating wind turbines
3 groups

Please nominate:

- Captain
- Time-keeper
- White board note taker
- Presenter
Please be ready to:

- Provide an answer
- Explain your discussions
- Review your findings on the flip-chart
The groups

#1  Christian, Jesper, Per K, Johan

#2  Henning, Mads, Søren, Per C

#3  Thomas (SWP), Jan, Chris, Peter
Please be back at...

15:07 PM

(Please include the coffee break)
Presentation of group results
Presentations

Flip-chart presentations from the 3 groups
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Academic update
Time blocks of Ph.d. (3 years)

Planning & start-up

ECTS (30)

Teaching & Supervision

Do work!!! (12 months)

2 conference papers
1 book chapter
1 article in press
1 article WIP

DTU Risø Vind udveskling

Stay abroad

Thesis writing

Feb 1, 2014
Start

Jan 31, 2017
End

52.8%
Tiered research questions

RQ1
Supply chain configuration

RQ2
Constituencies within shipping/logistics/SCM
Strategic role of shipping/logistics/SCM and share of LCoE

RQ3
Strategies & business models with focus on M&A to attain leadership position

Wind energy technology and market
I. Wind energy product technology development, market, and supply chains:

How do development in products technology (size, weight, structure/modularization), life cycles and market features (geographies, sizes, segments, national regulation, etc.) determine targets, strategies, and configurations of wind energy supply chains?
II. Strategic role of shipping and logistics in the supply chain:

How can shipping, logistics, and SCM activities contribute to the realization of targets and strategies for wind energy supply chains, and what is their share of LCoE?
III. Wind shipping, logistics, and SCM competitive leadership:

What competitive-, partner-, and operational strategies are viable for supply chain constituents to attain a leadership position in local, regional and/or global wind energy shipping, logistics, and SCM markets?
• Summary
• Introduction and background
  ✓ Status of knowledge indicating scientific context
• Theoretical framework
  ✓ Different per article
• Methodology
  ✓ Flyvbjerg on misunderstandings about case studies
• Short summary of each article
  ✓ Incl. rød tråd og "fit"

• Results seen as a whole
  ✓ På tværs af de enkelte artikler
  ✓ I forhold til 5 forskningsspørgsmål

• Conclusion

• References
Wrap-up and close
Closing of today

- Date
- Hosting company
- City

✓ Wrap-up
Next Reference Group meeting

Date suggestion: March, 2016

Any volunteers?
Today’s program

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Now let us proceed to room 230-231