Logistic Efficiencies And Naval architecture for Wind Installations with Novel Developments

Project acronym: **LEANWIND**
Grant agreement nº 614020
Collaborative project
Start date: 01st December 2013
Duration: 4 years

WP Framework/ Industry Challenges Report- supply chain and logistics
Work Package 5 - Deliverable number 5.1 - Executive Summary

Lead Beneficiary: EWEA
Due date: 30th June 2014
Delivery date: 7th July 2014
Dissemination level: PU

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No. 614020.

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Document Information

Version	Date	Description			
V0		Table of content with partners responsibilities			
		Name	**Prepared by**	**Reviewed by**	**Approved by**
			Ivan Pineda		
V1	14/05/14	Sections: 3.2.1, 3.2.2, 3.2.3, 3.3, 4.1.2,4.3,4.4			
V2	15/05/14	3.2.1	Federico D'Amico	Ivan Pineda	
V3	16/05/14	4.2.3	Dylan Jones	Ivan Pineda	
V4				Ivan Pineda	
V5	23/05/14	3.2.2, 4.2.1, 4.2.2	Elin E. Halvorsen-Weare	Ivan Pineda	
	27/06/14	3.2.1	Jan Goormachtigh & Hans Schroyen & Jeroen De Neve	Ivan Pineda	
V6	29/05/14	**4.5, 4.6**	Elena Reig	Ivan Pineda	
V7	06/006/14		Ivan Pineda	Ivan Pineda	
V8	13/06/14		Ivan Pineda	Jan Arthur Norbeck Paul Doherty Jesper Tang Kristensen	

V9	03/07/14		Manuela Conconi, Elin E. Halvorsen-Weare, Mar Rodriguez, Elena Reig Amoros	Jan Arthur Norbeck, UCC	Jan Arthur Norbeck, UCC

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Acknowledgements/Contribution	
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Definitions

CTV	Crew Transfer Vessel
O&M	Operation and Maintenance
MPV	Multi-Purpose Vessel
LCOE	Levelised Cost of Energy
GBF	Gravity Based Foundation
DP vessels	Dynamic Positioning Vessels
TLP	Tension Leg Platform
ROV	Remote Operated Vehicle
TTR	Time to Repair
OEM	Original Equipment Manufacturer
IMO	International Maritime Organisation
SES	Surface Effect Ship
US-CTV	Ultra Stable Crew Transfer Vessel
TAS	Turbine Access System
OHVS	Off Highway Vehicles
TTR	Time to Repair
PTV	Personnel Transfer Vessel

Executive Summary

This report aims to provide a broad overview of the state of art of logistics in the offshore wind industry. In particular, it will give a detailed review of the current methods and transport techniques used, from a project life-cycle perspective.

The three phases of a project life-cycle are analysed: installation, operation and maintenance (O&M) and decommissioning.

The overreaching need for the offshore wind industry is to achieve cost reductions across the board in its supply chain. The sector is optimistic about the prospects of cost reductions in both, the medium and long term. In the near term, it is believed that pressures in the market will drive standardisation and some immediate need of logistics optimisation. These two factors are believed to drive future cost reductions especially in installation and construction phases. Operating costs derived from O&M activities are foreseen to decrease as well but more in the longer term.

a. Installation

The installation process of an offshore wind farm is highly dependent on the type of substructure chosen. The report provides a summary of installation activities with a strong focus on the foundation types. The following different technologies are taken into account. For each of them the main features, advantages, disadvantages and logistics needs are analysed:

- Monopiles
- Gravity Based Foundations
- Jacket foundations
- Tripods
- Tripiles
- New foundations concepts: Suction bucket and floating foundations

The reports looks briefly also into cabling activities (general onshore activities and laying down ones), without entering into specific details.

b. Operation and Maintenance

During the O&M phase of an offshore wind farm, the logistic system supports the maintenance activities that are needed to reduce the downtime of the system and thus increase the production from the wind turbines. The report presents a summary of features and main characteristics of both infrastructures.

A brief review on models, tools and software for logistics is also presented. Models for offshore wind farms that look at the logistic systems can be divided into two main groups:

- Decision support models that consider main parts of the logistic system;
- Operational models that consider more short-term and day-to-day logistic operations and strategies.

This analysis highlighted that tools considering the logistic system for offshore wind farms seem to be scarce.

c. Decommissioning

Similar resources needed for installation are then needed for decommissioning. Decommissioning logistics also depends to great extent on the foundation selection. The decommissioning procedures will be completely different according to the type of support structure used, the water depth and soil conditions. Currently, the lack of experience in decommissioning offshore wind installations increases the risk that developers are unable to provide a fair valuation of decommissioning costs.

The report also performed a mapping of existing infrastructure for the offshore sector and identifies major bottlenecks to the deployment of the offshore sector. Moreover, an overview of the current offshore wind industry is provided: 69 online offshore wind farms in 11 European countries, 2,080 turbines installed and grid connected in European waters, making up 6,562 MW.

The scale of growth of the industry is not the only driver of the logistic challenges. As offshore wind market moves forward, new opportunities appear which present some technical challenges to be faced. The trends for the upcoming years are oriented towards the construction of larger wind farms in terms of capacity. This may require turbines with greater rated capacity (associated with an increase of mass and dimensions of the components) and moving the installation sites further offshore, implying greater distances to shore, as well as increasing water depths.

Vessels and equipment challenges will be driven by present and future developments but also by present gaps. Therefore, optimization for present conditions and components, together with adaptation and upgrading to meet the requirements of new farm sites, components concepts, and dimensions must be considered. The report includes a review of the main challenges for the different types of installation vessels covering:

- Self-propelled vessels and towed Jack up vessels
- Heavy lift vessels
- Vessels equipment
- Transfer vessels
- New concepts and specialised vessels

The report provides a short summary of equipment used in inbound logistics and their associated challenges, identifying lack of standardisation of handling procedures as the biggest challenge to overcome. Moreover, it provides a future outlook from the whole logistic perspective on what is needed to adapt across the entire project life cycle.

A list of topics identified as possible cost-reduction measures has been provided by the industry and presented in the report in section 3.3.

A section dealing with uncertainties and constraints is included in the report. Many challenges are well known; however, there is room for unexpected ones that pushes costs and risk throughout the entire logistics. A detailed explanation of each component uncertainty is given with some gaps of knowledge already identified.

Finally new logistics and solutions for further offshore wind farms are provided through a graphical and analytical method considering LEAN principles, especially focused on foundation and wind turbine installation logistics.

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