WP 5 Integrated Logistics

Stakeholder: Show case – Oostende, 8th October 2016

leanwind

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Outline

- Introduction
- Optimization based logistics decision support
- Summary and interaction of logistics models
- Demonstration

Introduction and summary of the presentation

In LEANWIND we have developed a holistic set of *optimization based decision support systems* for all life cycle phases and supply chain legs.

These tools are all innovative and *state of the art* within offshore wind farm logistics planning.

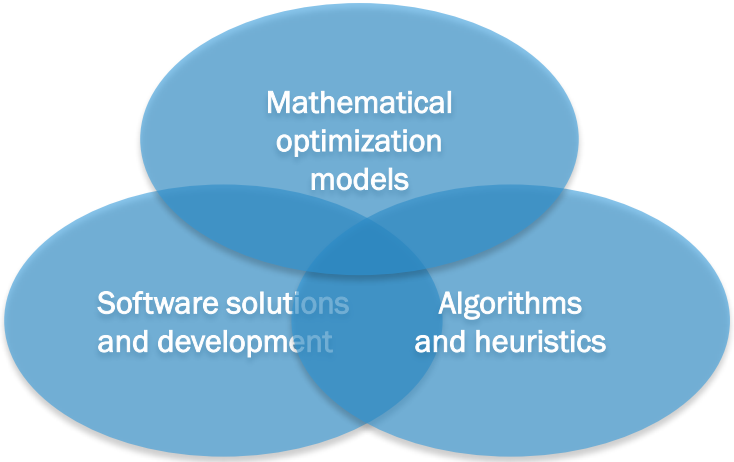
They enable the logistic planners to

- Be *more efficient* in the planning process
- Produce *better and more reliable logistics solutions*

Lessons to be learned from other industries: Operations Research

Operations Research (OR):

The study of how to develop mathematical models of complex engineering and management problems and the corresponding solution process.



Major application areas today:

- Petroleum industry
- Aviation
- Production planning
- Distribution
- Finance (portfolio optimization)
- Energy production

Lessons to be learned from other industries: Logistics and planning tools

MEGAVIND:

"there is need for improved planning and logistics tools, new organizational and management tools as well as innovative business models."

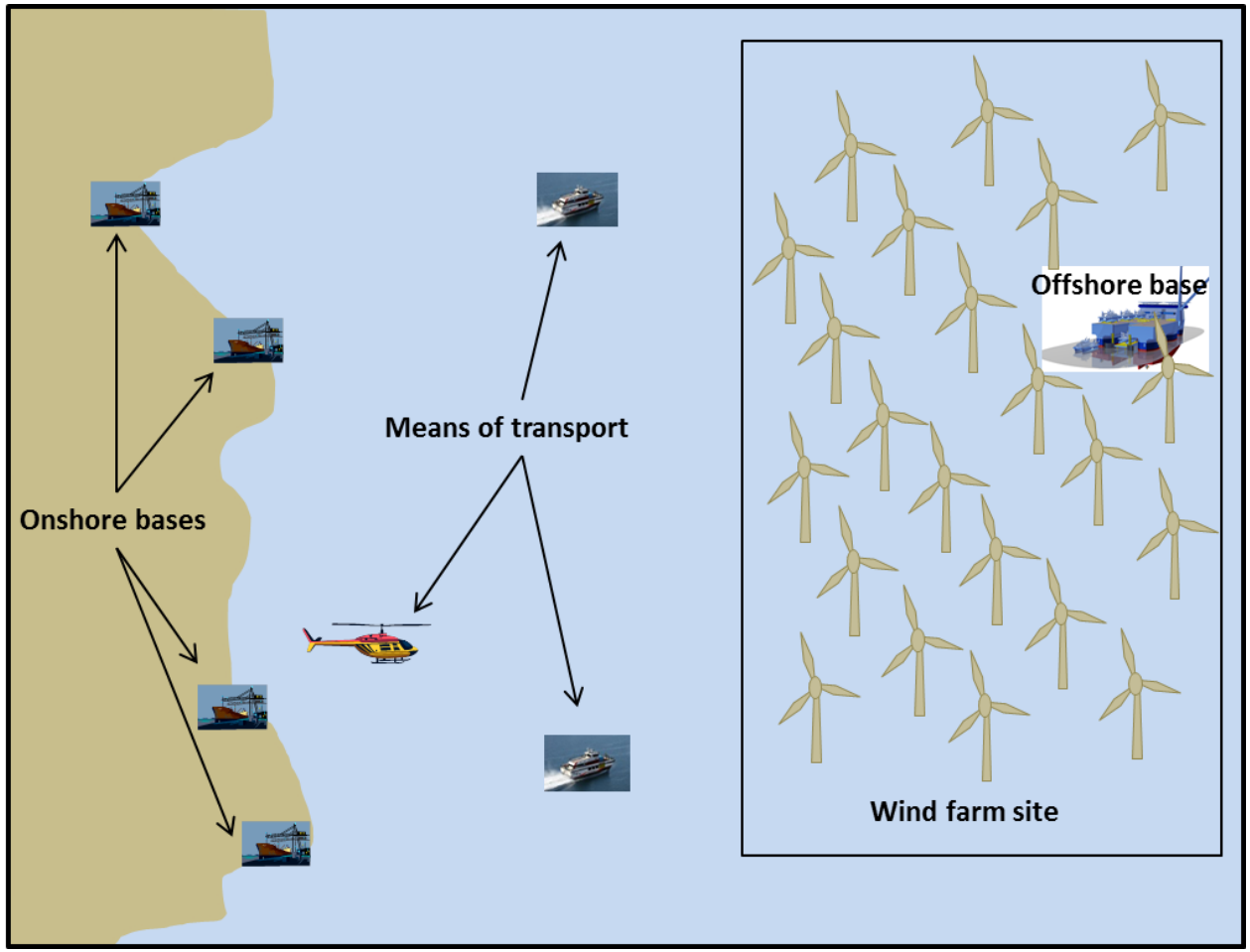
In general within offshore wind:

- Lack of structured planning processes
- Complex operations
- Lack of advanced tailormade decision support tools

Complex logistics operations

- Maintenance operations
  - Inspections, manual reset, repair, replacement, annual service
- Weather restrictions
  - Wave (height, period, heading), wind (speed, direction), current
- Vessel characteristics
  - Speed, accomodation, fuel consumption, crane capacity etc.
- Access solutions
  - Fender based, motion compensated devices
- Vessel costs
  - Spot, long term charter, own vessel
- Infrastructure
  - Offshore base(s) (mother vessel, fixed platform)
  - Port(s)
  - Inventory location(s)
  - Production facilities

Transport and logistic system for offshore vind



Why Optimization?

Example: O&M logistics model from port to wind farm:

We want to find the fleet of vessels and set of ports to minimize the cost of maintaining an offshore wind farm

This is difficult because:

There exists a LOT of different vessel types out there, all with their strengths and weaknesses

Vessel concepts

Vessel concepts

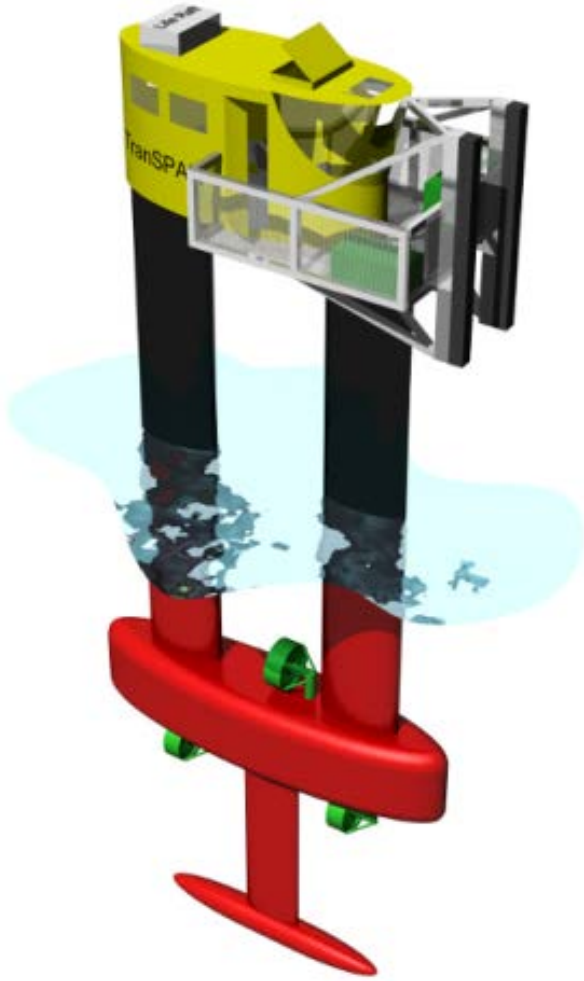
Vessel concepts

Vessel concepts

"Vessel" concepts

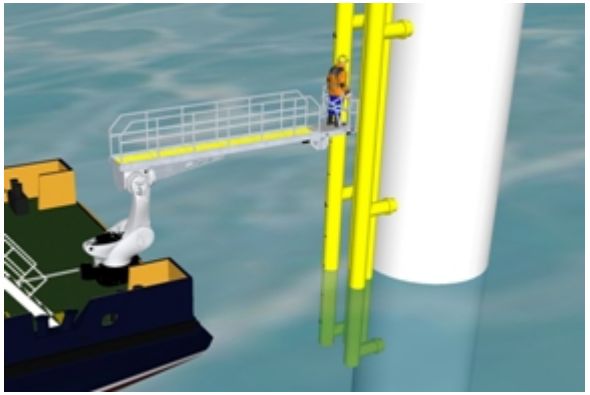
Vessel concepts

Vessel concepts



Mother vessel concepts

Access solutions



The weather conditions, distance to shore and port characteristics are unique for each site

The best fleet at Dudgeon is probably no good at Doggerbank, etc.

- Optimization uses a mathematical model of the problem to explicitly or implicitly evaluate all combinations in an efficient way

- Finds the best fleet of vessels and set of ports tailored to the wind farm's location and weather conditions

Logistics models developed in LEANWIND

- A holistic set of logistic models for all life cycle phases and supply chain legs
- Nine inter-connected optimisation models

	Installation	O&M	Decommissioning
Prior to Port	PTPIns	PTPOM	IntDis
At Port	Portlay, PortIns	PortOM	PortDis
Port to Site	VMIns	VMOM	IntDis

Installation phase

PortLay (Installation phase, at port segment): this is a model for optimal port layout to support an OWF. It is developed in Deliverable 5.5 of the LEANWIND project [11]. It is for use in the installation phase, where significant amounts of wind farm parts may need to be stored at the port. It ensures that this is done in a cost effective manner.

PortIns (Installation phase, at port segment): this model determines the optimal installation support port choice from amongst a set of given candidate ports for a proposed OWF site. It is developed as part of LEANWIND Deliverable D5.3 [12]. A set of multiple criteria for measuring the appropriateness of an installation port is used in this process, including the optimal layout from the Portlay model where appropriate.

PTPIns (Installation phase, prior to port segment): this model determines the optimal arrangement of the portion of the supply chain prior to port from initial production of major turbine parts until their arrival at the OWF installation support port (determined by the PortIns model). The full description of this model is given in Section 3.1.

Installation phase

VMIns (Installation phase, port to site segment): This model determines the optimal mix and scheduling of seaborne vessels required to transport the wind farm components from the OWF installation support port (determined by the PortIns model) to the OWF site. The model is developed as part of LEANWIND Deliverable D5.6 [10].

O&M phase

PortOM (O&M phase, at port segment): this model determines the optimal O&M support port choice from amongst a set of given candidate ports for a proposed OWF site. It is developed as part of LEANWIND Deliverable D5.3 [12]. A set of multiple criteria for measuring the appropriateness of an O&M port is used in this process.

PTPOM (O&M phase, prior to port segment): this model determines the optimal arrangement of the portion of the supply chain prior to port from production of replacement turbine parts until their arrival at the OWF O&M support port (determined by the PortOM model). The full description of this model is given in Section 4.1.

VMOM (O&M phase, port to site segment): This model determines the optimal mix and scheduling of seaborne vessels required to transport the replacement wind farm parts from the OWF O&M support port (determined by the PortOM model) to the OWF site. The model is developed as part of LEANWIND Deliverable D5.6 [10].

Decommisioning phase

PortDis (Decommissioning phase, at port segment): this model determines the optimal decommissioning support port choice from amongst a set of given candidate ports for a proposed OWF site. It is developed as part of LEANWIND Deliverable D5.3 [12]. A set of multiple criteria for measuring the appropriateness of a decommissioning port is used in this process

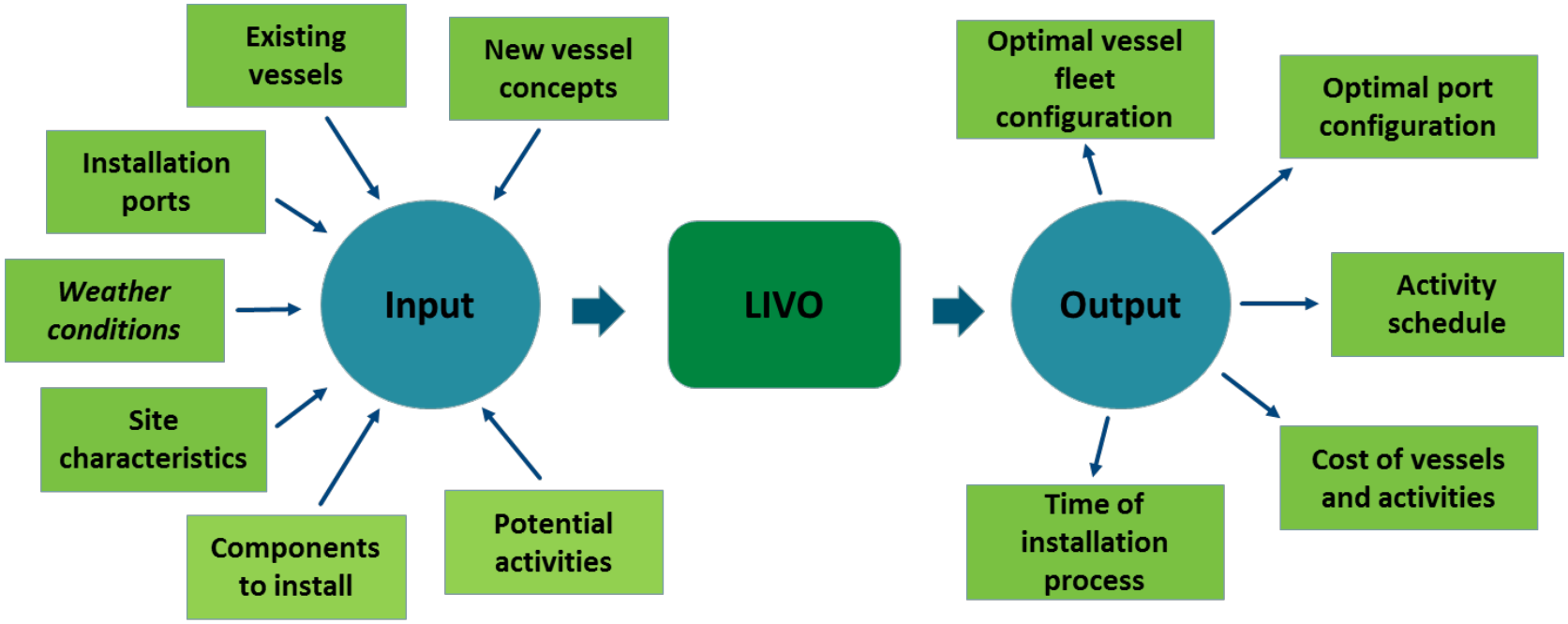
IntDis (Decommissioning phase, prior to port and port to site segments**):** This is an integrated decommissioning model that considers the optimal means of the decommissioning an OWF from site, through a port or set of ports (chosen by the PortDis model) and onto a set of disposal and recycling points. The full description of the model is given in Section 5.2.

Different type of logistics decision support

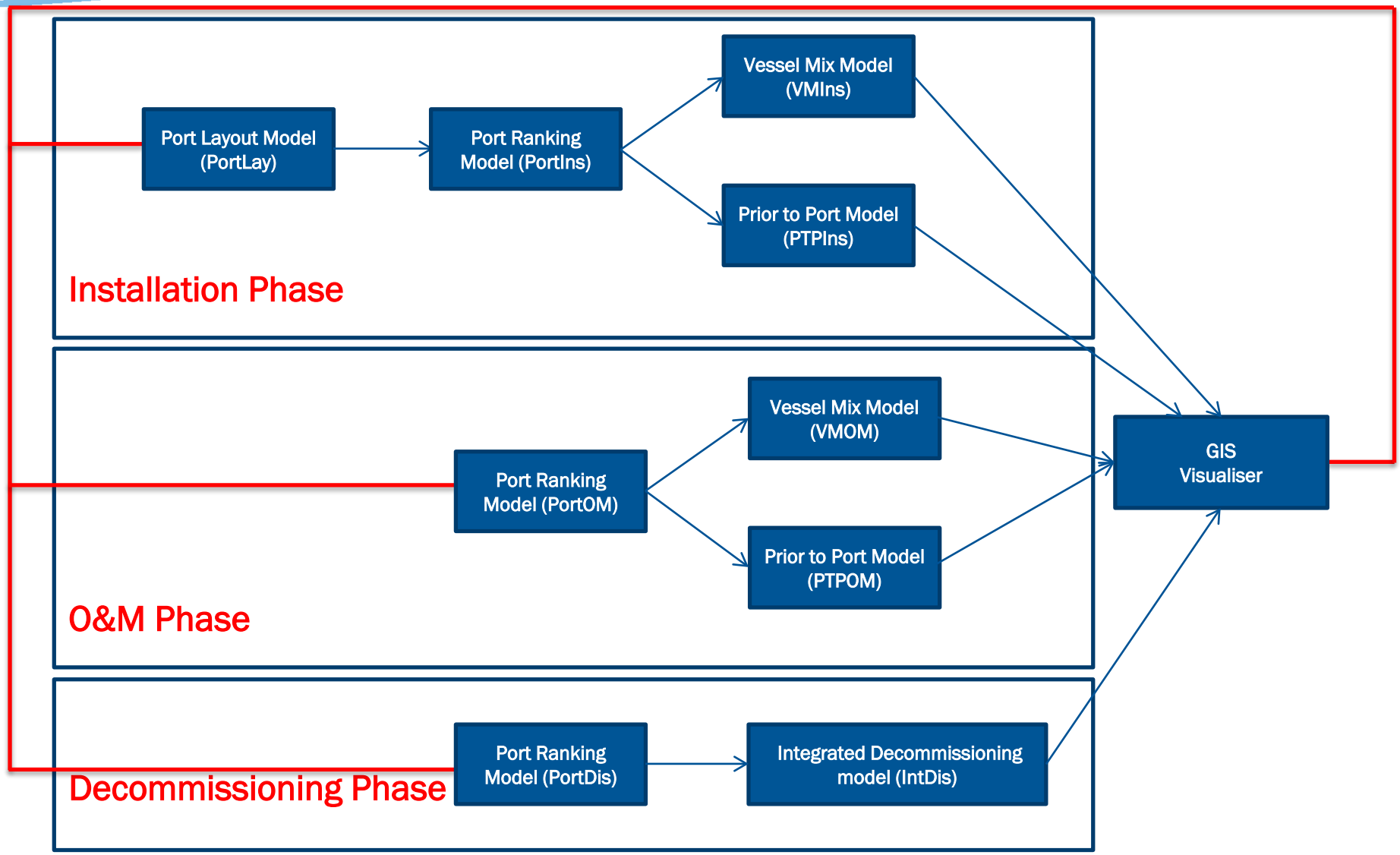
Type of models

- Port layout
- Port selection
- Resource and activity optimization
- Total decommisioning activity optimization

Example: Offshore Installation model



Overview of interaction between logistics models



Example of application areas

- Maximization of operator-profit
  - Choosing right strategy for fleet composition and usage
- Investment analysis/financial evaluations
  - Choosing right fleet (long term vs short term chartering)
  - Choosing right infrastructure (ports, production facilities…)
- Managing risk and uncertainty
  - Through fast and extensive sensitivity analyses and optimization
- Evaluation of innovative/future vessel and logistics concept
  - Choosing right vessel concept for future operations

Summary

- LEANWIND WP5 contributes to reduced LCOE within offshore wind through
  - Structured planning processes
  - Advanced tailor made decision support tools

- This results in:
  - Faster and more focused decision processes
  - Standardised and reliable calculations (less humans errors)
  - Improved expert decisions through better information background

Short demonstration example: O&M model for port to offshore wind farm

Logistic decision support tool for the O&M phase:

- Determines the vessel fleet (number and type of vessels and possible helicopter) and which ports or bases they should be associated with on a long term basis
- This will of course depend on the expected operation and maintenance activities that again will depend on the expected weather, failure, availability of components and resources, possible loss of production etc.

Thank for your attention!