Module: Digitalization in Offshore Wind Energy

Hochschule Bremerhaven, Bremerhaven, Germany & Business Academy Southwest, Esbjerg, Denmark

Module Type: Core/Elective Module Contact time: 30 hours
Frequency offered: Every 18 months Group size: max. 15 participants

ECTS/weighting: 5 ECTS / 0.083 Full-time equivalent Self-Study: 120 hours
Offered in: Esbjerg, Denmark

Course theme

While the fossil fuels industries have had more than 100 years to perfect their ways of operation and production, the offshore wind energy industry is still relatively new, which means that there are still significant room for the industry to increase both effectiveness and efficiency through use of digitalization.

Digitalization is revolutionizing the energy sector by improving productivity, safety, accessibility, and sustainability of energy systems. New, smarter ways of modeling, monitoring, analyzing, and forecasting various facets of energy development, production and consumption are key in this green energy transition that has helped to gain multiple environmental benefits.

This transformation has also affected the entire wind energy supply chain, from wind turbine manufacturing to wind farm operation and decommissioning. Moreover, digitalization will also help fostering new processes, networking opportunities and business models.

Going forward further digitalization of wind farm construction, operation and maintenance will be a major driver for improving performance and reducing costs and financial risks.

Top priorities for further digitalization in the offshore wind industry: *(DNV report 2019)*

- Improving operational efficiency (identified by 52% of respondents)
- decision making (42%)
- cost efficiency (40%)

The module will focus on HOW digitalization can help organizations to develop effective digital strategies that create business value for employees, customers, stakeholders, and society.

Aim and content:

Learning outcome:

Based on industry examples this module will introduce participants to concepts, methods and tools to improve their understanding and application of digital thinking in the OWE. This will take place throughout the full lifecycle of offshore wind infrastructure - from surveying, planning, design, logistics, operational support, training and decommissioning. Furthermore, this module also presents the use of generic technologies enabling many of the previous digital applications i.e. big data analytics, 5G technology, AI, cloud computing, blockchain and IoT. Potential benefits and challenges of these technologies will be presented, and participants will get opportunities to discuss, compare and contrast applications and potential implications.

Content

The availability of large amounts of data has a profound impact the wind energy industry. From turbine design to plant layout, construction, commissioning and O&M, new processes and business models are emerging. As seen in numerous other industries and businesses, digitalization leads to improved efficiencies and greater insight, ultimately leading to enhanced energy capture and savings for wind energy resulting in energy cost reductions. Digitization also helps drive collaboration both in terms of speed, ease, and accessibility. However, digitization also faces major challenges:

- A need to create reusable data frameworks. It is often required to combine and use data from many different sources and disciplines. Siloed data is the biggest obstacle to operational efficiency as data is the underlying factor for all other digitalization elements to build upon.
- A need to connect people to data to foster innovation. Regardless of form data tells a story. It can identify cost savings and efficiencies, new connections and opportunities as well as an improved understanding of the past to shape a better future
- A need to enable collaboration and competition between organizations. The major challenges thus include a combination of technical and cultural aspects, which will require strong cooperation between companies, the academic world and the public sector to solve.

Working to mitigate these will position wind energy as an essential part of a global clean energy future.

This module offers a framework for digital thinking within the offshore wind industry. The main topics centers around:

- Digital transformation: Enables a connected process between plant, supply chain, OEMs, customers, and other stakeholders to ensure quality, availability of products, a proper feedback system, and customization of products, ensuring continuity and a sustainable process.
- Cybersecurity: Ensure safe platforms with continuously upgraded strong security standards
- Industry 4.0 (connectivity through cyber-physical systems) vs. Industry 5.0 (integrated relationship between "man and machine")
- Adopting new technologies to help adapt products to changing requirements
- Digital twins: Simulation and testing before actual implementation to ensure product precision and faster execution without bottlenecks
- Asset performance management by using real-time diagnosis to predict and plan maintenance schedules
- Product life cycle management by integrating and simulating the compatibility of all components of a new product in real-time, and to plan for a successful launch
- IIoT-driven automation that integrates plant, logistics, and supply chain management
- Man/machine collaboration for better precision, faster execution, personification of products, and minimization of waste

Teaching methods

- Innovative teaching methods: We strive for real-life competencies needed in the industry. During class, actual consultancy tasks and problems will be presented, and the MBA students will then apply theory in a real-time scenario and solve actual problems for the partner firms.
- Self-study: We expect the participants to hold a high degree of self-discipline and show up well prepared for class, being motivated to share their knowledge.
- Live cases: Business cases will be analyzed to prepare the participants for future leadership requirements within wind energy.
- Workshops: Students will meet up physically twice for two days during the module to solve actual problems raised by partner firms.
- Forum, chat and messaging: All students can get in contact with their lecturer and fellow students to discuss, elaborate and clarify issues, ask questions and exchange views.

Examination

To be able to pass the course, the participants must show understanding of the theory, be able to put the theory into a practical context and create good solutions for the study cases. The form of evaluation is a portfolio, which will consist of:

- Active involvement during physical workshops
- Oral and written presentation of assignments (including eventual updates)
- Reflection over the course and feedback

General learning outcomes

Students will be able to...

- Autonomously read on new theories and methods (LO1)
- Apply new theories and methods to practical challenges (LO2)
- Evaluate upon application of theory and methods (LO3)
- Manage complex situations in offshore wind energy industry (LO4)
- Identify risks and challenges by analyzing data gathered and use them for decision making (LO5)
- Integrate business knowledge, analytical skills and management techniques for planning and controlling (LO6)
- Evaluate consequences of solutions (LO7)
- Show leadership capacity and teamwork skills (LO8)
- Communicate challenges and solutions to relevant stakeholders (LO9)

Academical subject director:

Flemming Østergaard, Business Academy Southwest

Lecturer profile and Co-lecturer profile:

Academic lecturer: Rasmus Dovnborg Frederiksen from Siemens Gamesa Renewable Energy A/S, with profound knowledge of digitalization within Offshore Wind.

Co-lecturer: Michael Bjerrum, from Shoreline Wind, focusing on digitalization through counselling, processing, business/product development and operation.

Business case description:

A concrete case provided by co-lecturer, where students will focus is on **HOW** digitalization can help the organization to develop effective digital strategies that create business value for employees, customers, stakeholders, and society. Ideally this should include an assessment of the problem followed by potential solutions and their implications and consequences.

Self-assessment questions:

The student will assess her/his knowledge of the subject, study the provided literature, consider other sources of knowledge and consider own ideas of opportunities and challenges digitalization.

- What do I know about digitalization (related to the OW industry)?
- What does the provided literature tell me?
- Wich platforms or forums might be of interest for further knowledge gain?
- Wich critical elements should I consider?
- Do I see an opportunity for me or the company I work for?
- How could businesses collaborate and leverage the opportunities?

Literature:

A review: Challenges and opportunities for artificial intelligence and robotics in the offshore wind sector, Daniel Mitchell et al. 2022

Grand Challenges in the Digitalisation of Wind Energy, eawe European academy of wind power 2022

Wind energy digitalization towards 2030 - Cost reduction, better performance, safer operations, Wind Europe, Nov 2021

Digitalisation for the transition to a resource efficient and circular economy, Eva Barteková and Peter Börkey, OECD 2022

Material (for inspiration):

https://www.nsenergybusiness.com/features/a-benefit-for-the-wind-industry-how-digitalisation-can-save-time-and-money/

https://wes.copernicus.org/preprints/wes-2022-29/wes-2022-29.pdf