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# D5.5 Overall summary of the industrialization process

The ambition of this deliverable is to provide input for a roadmap to an industrialized development of FOWT technology by briefly summarizing on the following key objectives:

1. Industrialization of floating wind in general and differences to fixed-bottom wind
2. The development of an industrialized numerical design process for FOWTs
3. Industrialized procedure for the transition from conceptual to detailed design
4. Key areas from design conceptualization to manufacturing process development
5. Development of a generalized manufacturing methodology for the large-scale production
6. Economic considerations during offshore operations

Furthermore, information regarding the design of internal structures and opportunities for structural optimisation are provided. A proposal for a design methodology using coupled simulations combined with structural analysis is made. The application of a method based on analysis of instantaneous quasi-static states is demonstrated and used iteratively to obtain the instantaneous stresses for predefined time steps. The results are then used as inputs for Finite Element analysis. This methodology is exemplified by using a generic concept, which was designed according to the specifications of the LIFES50+ project Task 5.3 on industrialisation processes.

As the technology matures and gradually reaches the stage where it needs to be mass-produced, the manufacturability of the concept needs to be assessed. A Manufacturing Readiness Level (MRL) questionnaire was used with concept designers as part of the assessment procedure. The MRL questionnaire may be utilized as a template for future design assessments. TRLs and MRLs should ideally propagate in conjunction and any existing TRL and MRL gaps should be reduced to enable industrialisation of the designs. An overview of the current level of manufacturing maturity of selected FOWT concepts is presented and the interdependencies of the technological readiness with manufacturing and commercial readiness are described.

One of the main conclusions of the MRL assessment is the need for a manufacturing proof of concept to increase the manufacturing maturity. Ramboll in cooperation with concept designers, subcontracted third-party consulting companies specializing in offshore manufacturing and con-ducting a fabrication study separated for steel and concrete. This established an interactive loop between the concept designers and the experts in steel and concrete structures. An outcome is a generalized manufacturing methodology taking the manufacturing constraints into consideration. The study considered a mass production scenario for producing 50 FOWT units in 2 years, each unit supporting a 10 MW turbine. Recommendations and industrial best practices at various stag-es of the FOWT development life-cycle are highlighted. A comparison of manufacturing methodologies is made.

The installation procedure of a FOWT after manufacturing generally consists of load-out, transit to site and hook-up to mooring lines and dynamic cable. To facilitate the installation process and minimize costs, three main logistical aspects have to be considered: vessel requirements, distance from port to site and weather impact. The weather mainly impacts the installation procedure due to sensitivities of required marine operations to wave height and wind speed. This impact increases for larger distances. Furthermore, the floater towing speed, draft and other requirements, mooring and dynamic cable hook-up times and procedures and other technical aspects greatly influence installation, particularly for TLPs. For floating wind substructures, only limited information about the decommissioning process is available. Generally, floating devices will be detached from the mooring lines and towed to the shore for further decommissioning. Mooring lines may be recovered while pile anchors remain in the sea bed.