

This manuscript discussed the potential implementation and solution of building the digital twins for offshore wind farms under the context of industry 4.0. The study of the digital twins for offshore wind farms falls into the scope of WES.

No.	Comments	Answers
1.	<p>After conducting a thorough review of the manuscript, "Industry 4.0 Digital Twins in Offshore Wind Farms," I believe that the paper has significant potential but requires substantial revisions before it can be considered for publication. Hence, I suggest that the manuscript should be reconsidered after major revisions.</p>	<p>Thank you for the comment, we have revised the manuscript taking into account the inputs from the 1st reviewer which we believe has significantly improved the manuscript.</p> <p>Hopefully it becomes clearer and more understandable for people of wind energy community in this regard.</p>
2.	<p>In general, this manuscript tries to combine the research paper review and a case study together, which causes the consequence of limiting the depth of investigation and discussion in both areas. For instance, in session 3, the paper provides a list of research papers in the field and categorizes them based on their main purposes. However, the presentation in this section lacks clarity and depth, making it challenging for readers to grasp the main insights and the connections between these studies.</p>	<p>Thank you for the comment. As we mentioned on the 1st paragraph of section 3, "...Recently, researchers have categorized digital twins based on their specific applications. For example, ... in general... in industry... maturity level pertaining to its application... in smart farming..." meaning that until now, digital twin concept is defined based on the purpose and application. That is why we categorized them based on the main purpose following the product stages: "...In the early stages, digital twins are primarily used for modelling and estimation purposes, while in later stages, digital twins are utilized for controlling, monitoring, and predicting..."</p> <p>Here, the main application is in offshore wind farm with more specific application summarized in table 1.</p>
3.	<p>On the case study part, the details of the simulation are not well presented, and the results are plainly listed, which causes a</p>	<p>Thank you for the comment. As we mentioned on the simulation section (1st paragraph), "...The simulation section serves as an intermediary between the</p>

	<p>gap between the simulation result discussion and the final drawn conclusion “AAS could be a promising option for enhancing the functionality of digital twins in offshore wind farms.”</p>	<p>data sources and the visualization section...” meaning that the simulation input is the data sources and the simulation output/result is the visualization (3D, 2D, and augmented reality) as seen in Figure 3,4, and 5. We admitted that we did not explicitly mention this on our original manuscript, therefore we have revised it.</p> <p>As we mentioned in the conclusion section, “...We discovered that the frameworks applied in offshore wind farms were insufficient in achieving interoperability... Meanwhile, in the manufacturing industry, Asset Administration Shell (AAS) has been promoted as a promising framework for implementing digital twins... We found that the literature highlights OPC UA as the recommended tool... Next, we evaluated a case study from our previous work that applied digital twins for offshore wind application based on OPC UA... Inspired by the work of Cavalieri et al. (2019) and Cavalieri et al. (2020), we presented the conceptual application of an OPC UA-based AAS as an interoperable digital twin solution within the case study...”</p> <p>Simply said:</p> <p>First, the literature highlights OPC UA as the recommended tool for AAS.</p> <p>Second, we have a case study implementing digital twin in offshore wind farm using OPC UA (which has been successful as shown in the visualization results as output).</p> <p>Third, we investigated the AASX Package Explorer tool that can connect AASXServer with OPC UA.</p>
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4.	<p>I fully acknowledge the efforts from the authors of gathering a substantial amount of research papers and performing simulations. However, I think the authors should clarify the scope of their article, deepen the investigation/discussion making the article more appealing and insightful for the wind energy community that reads this journal.</p>	<p>Thank you for the input. We mentioned on introduction section (4th paragraph) about our main contribution which is addressed on three objectives. Moreover, we intentionally created our research approach diagram (Figure 1) and the detailed explanation in methodology section 2, in order to clarify our article scope. We believe that the revised section 1 and 2 can make the article more appealing and insightful not only for ICT community, but also for wind energy community.</p>