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SAFETY AND RISK ASSESSMENT OF OFFSHORE WIND TURBINES: THE HUMAN FACTOR PERSPECTIVE

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ABSTRACT

The limited research on the adverse implications of offshore wind turbine operations on the health and safety of workers. Workers are exposed to harsh weather conditions, including falling ice from the blades, electromagnetic radiation, and electrocution from high-voltage wires. The study aims to identify reported associations between offshore wind turbine operations and potential health risks for workers, conduct a risk assessment, and provide mitigation measures to address identified risks. The use of Digital Twin technology will be employed to create and test the future risks of the new energy system.

Keywords: *Offshore Wind Turbine, Risk Assessment, Hazards Identification, Digital Twin, Digital Twin Technology*

1.0 INTRODUCTION

The safety risk assessment of offshore wind turbines from a human factor perspective involves evaluating potential risks and hazards associated with offshore wind turbine operations, including harsh weather conditions, ice formation, electromagnetic radiation, electrocution, and personnel transportation to and from the turbines. It is important to consider the impact of these factors on the safety and performance of offshore workers and to implement appropriate mitigation measures to minimize the likelihood of accidents and injuries. The use of Digital Twin technology can be employed to create and test the future risks of the new energy system, and effective training programs and safety culture development are also crucial to ensuring safe offshore wind turbine operations from a human factor perspective.

2.0 MATERIALS AND METHODS

This research requires an appropriate methodological framework in order to follow a user-focused procedure. To respond to the research questions, it is important to collect, analyse, and evaluate data. This chapter examines various user-centric frameworks and approaches that can be utilised to produce a UX design for the operation and maintenance of Digital Twin Technology. The figure 1 below summarises how human factor elements will be integrated into digital twin technology :

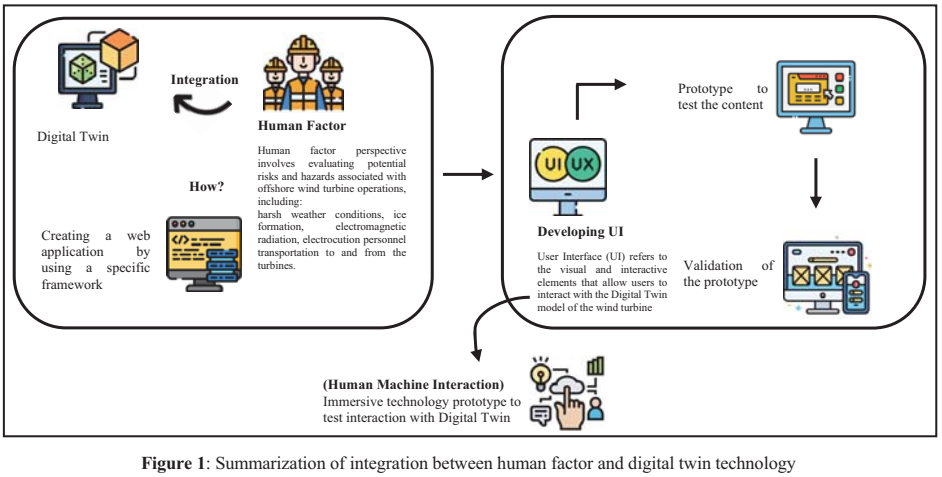

Figure 1: Summarization of integration between human factor and digital twin technology

Perdomo et al. propose a user-centered system design methodological paradigm for developing web applications [1]. The process is divided into several stages, starting with planning, where the purpose, audience, goals, and

requirements of the site are determined. User profiles are generated based on the information collected, which serves as the basis for information structure during the design phase. Prototypes are evaluated early in the development phase using heuristic evaluation and user testing to assess key elements of the interface. The authors discuss various properties of an application, such as structure, navigation, layout, search, accessibility, assistance, control, and feedback. The goal is to identify faults and rectify them to achieve effectiveness, efficiency, and user satisfaction in achieving specific goals in certain contexts.

Information architecture (IA) is the structure behind an application with the purpose of meeting the information needs of users. It involves structuring, classifying, and labeling content, organizing it in a way that fits users' informational needs. [2]. For a digital twin (figure 2) in operation and maintenance, IA can be categorized into many profiles, with the basic profile containing the least amount of information and the asset manager profile containing the most. The article presents six options available on the main menu for the basic profile, including decomposition, monitor, search, notes, task list, and explore. A prototype is developed to test the IA's content, which helps determine whether it contains logical ordering and unambiguous labeling of requirements. By converting the IA into a physical prototype, it becomes easier to comprehend and test.

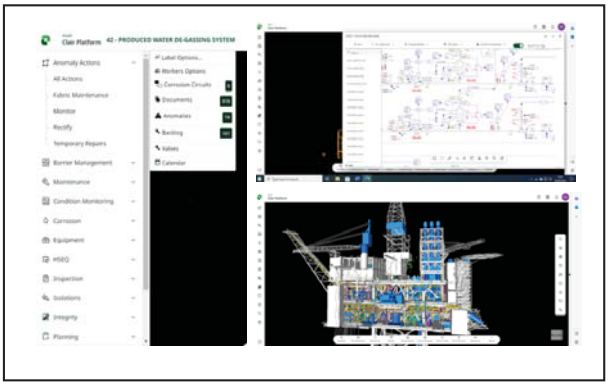

Figure 2: Digital Twin Technology

SUMMARY AND CONCLUSION

Incorporating human factors into digital twin technology can bring several benefits. Firstly, it can improve usability as digital twin technology can be complex and difficult to use, especially for non-experts. By incorporating human factors such as user centered design and user testing, designers can create digital twin interfaces that are more intuitive and easier to use, leading to increased user adoption and productivity. Secondly, it can enhance safety in high-risk environments, such as industrial processes and infrastructure, by incorporating human factors such as ergonomic design and situational awareness. This can reduce the risk of human error and improve the ability of operators to respond to emergencies. Thirdly, it can improve decision-making by creating interfaces that help users make better-informed decisions based on the data available through data visualization and decision support tools. Lastly, it can increase efficiency and productivity by creating interfaces that incorporate human factors such as task analysis and workflow optimization, which can help automate and optimize industrial processes. Overall, incorporating human factors into digital twin technology can make it more accessible, safer, and more effective for users across a wide range of industries and applications.

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