Proceedings of the 33rd European Safety and Reliability Conference (ESREL 2023)
Edited by Mário P. Brito, Terje Aven, Piero Baraldi, Marko Čepin and Enrico Zio

doi: 10.3850/978-981-18-8071-1_P631-cd

DIGITAL TWIN TECHNOLOGY FOR RISK MANAGEMENT OF THE SAFETY-CRITICAL SYSTEMS IN THE ENERGY TRANSITION

Nurhasnita Hamzah[1], Michael Grant[2], Maureen Jennings[1,*], Henry Tan[1,*]
[1] School of Engineering, University of Aberdeen, Aberdeen AB24 3UE, UK; n.hamzah.22@abdn.ac.uk
[2] BP International Limited, Wellheads Road, Dyce AB21 7HG, UK; michael.grant5@bp.com
[*] Correspondence**:** maureen.jennings@abdn.ac.uk
[*] Correspondence: h.tan@abdn.ac.uk

ABSTRACT

Digital twin technology enables engineers to identify and address potential faults and hazards in a product's design prior to completion. This approach encompasses risk management solutions such as automation and monitoring systems that contribute to the protection of people and property. By simulating real assets in virtual environments, digital twins supply valuable data that facilitates risk analysis and identification of potential accident scenarios. Incorporating human factors in digital twins fosters the development of safety-critical systems, particularly within the context of the energy transition. The industry is expected to establish regulations for data storage, driven by the growing prevalence of digital twin technology.

Keyword: *Digital Twin, Digital Twin Technology, Risk Analysis, Risk Assessment, Safety-Critical System, Energy Transition*

1.0 INTRODUCTION

Digital Twin technology is used to manage risks associated with safety-critical systems during the energy transition. It creates virtual replicas of physical assets, allowing operators to predict and identify potential risks and issues before they occur. Digital Twins can monitor and manage safety-critical systems such as power grids, offshore wind farms, and nuclear power plants. By simulating different operating scenarios, operators can identify the most efficient and safe way to operate the system, improving its efficiency and reducing the likelihood of safety incidents. Overall, Digital Twins are a powerful tool for managing risks and ensuring the safety and reliability of the energy system during the transition to a sustainable energy future.

2.0 MATERIALS AND METHODS

For safety-critical systems in the energy transition, a suitable methodological framework is required, depending on the specific application and the system being monitored [1]. This section discusses materials (Figure 1) that may be required to achieve a design that can form a good user interface and experience include:

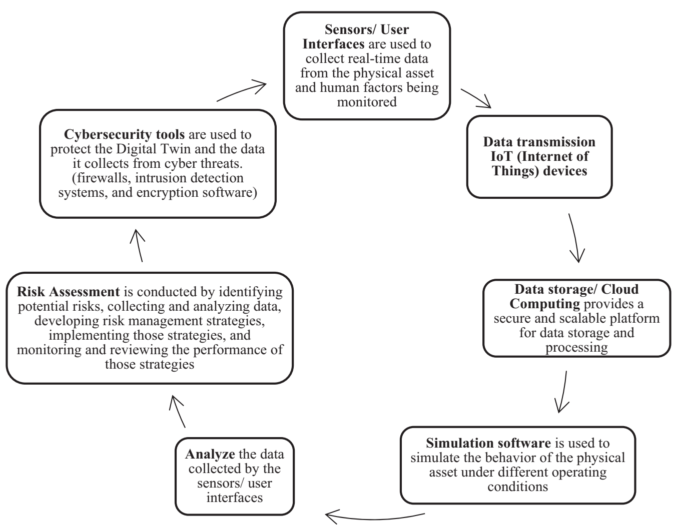

Figure 1: Digital twin technology for risk management

The methodology for using digital twin technology for risk management involves several steps, including identifying the safety-critical system, by using an existing Digital Twin Technology (Figures 2-5), identifying risks, developing mitigation strategies, testing and validation, and implementation [2]. By following this methodology, stakeholders in the energy transition process can effectively manage and mitigate risks associated with safety-critical systems, improving the safety and reliability of the energy system.

Figure 2: Laser scanning for digital twinning using Cintoo cloud

Figure 3: One click away of Smart P&ID in digital twin

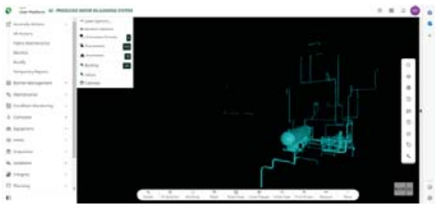

Figure 4: Digital twin of selected systems at the offshore operation

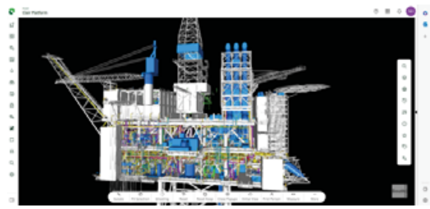

Figure 5: Digital twin streamlined offshore operations

SUMMARY AND CONCLUSION

Whilst the use of digital twin technology for risk management is still relatively new in the energy sector, its potential benefits are clear. As the energy transition continues to gather pace, the use of digital twin technology is likely to become increasingly important for managing the risks associated with safety-critical systems. By embracing this technology and developing robust risk management strategies, we can help ensure a successful transition to a more sustainable energy future.

ACKNOWLEDGEMENT

This research is supported by BP International Limited.

REFERENCES

1. Attaran, M., & Celik, B. G. (2023). Digital Twin: Benefits, use cases, challenges, and opportunities. Decision Analytics Journal, 6, 100165. https://doi.org/10.1016/j.dajour.2023.100165
2. Agnusdei, G. P., Elia, V., & Gnoni, M. G. (2021). Is Digital Twin Technology Supporting Safety Management? A Bibliometric and Systematic Review. *Applied Sciences*, *11*(6), 2767. https://doi.org/10.3390/app11062767