Chapter 7
Use Cases for Digital Twin

Imdad A Shah
School of Computer Science SC, Taylor's University, Malaysia

Quratulain Sial
Emergency Department Aga Khan University Hospital, Karachi (AKUH), Pakistan

N. Z. Jhanjhi
https://orcid.org/0000-0001-8116-4733
School of Computer Science, SCS Taylor's University, Malaysia

Loveleen Gaur
https://orcid.org/0000-0002-0885-1550
Amity University, India & Taylor's University, Malaysia & University of the South Pacific, Fiji

ABSTRACT

The "digital twin" concept creates a virtual portrayal, with the actual and virtual worlds being in perfect sync. The digitization process of a product's whole life cycle, from design to maintenance, will provide the organization with a predictive analysis of problems. Using digital representations' maximum effect of predicting issues in the development of technology would be to deliver caution in advance, avoid any disruption to the new opportunities, and design an upgraded technology. Indeed, these will have a greater impact on transmitting outstanding consumer feelings both inside and outside the company. Emerging trends of Industry 4.0, such as AI, ML, DL, and IoT play a crucial part in the creation of virtual twins, mainly used in the manufacturing, industrial IoT, and automotive industries.

INTRODUCTION

The ability to unleash various potentials of virtual product creation has increased with the use and sophistication of simulation models. While simulation software has gotten increasingly powerful, attempts to maximise the potential benefits of product simulations are increasingly centred on the input data that is now accessible. More accurate simulation models that ultimately produce better products can be created. The definition, upon which this work is based, states that "use phase data" refers to data generated

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by the product itself during the usage phase. The term "digital twin" is frequently used to describe such integration of simulation models and the usage of phase data (Autiosalo, 2019). In this contribution, a "digital twin" is defined as "a virtual, dynamic representation of a physical system that is connected to it over the whole life cycle, enabling bidirectional data exchange (Latif, 2020) the heating and cooling systems industry partner of this case study, like many other businesses today, is having trouble changing from a "conventional" mechanical engineering firm to a forward-thinking business that fully embraces digitization. Although the goods currently in use are technically sound and frequently already supply some basic data from the usage phase, the promise of data-driven engineering and the integration of the devices on the Internet of Things are just now being realized. Some initial steps have been made, such as allowing customers to use an app to control their heating system (Tao, 2018; Beil, 2020; Bentley Systems, 2021). Digital twin technology is becoming important for digitization. Although there are many potential advantages for businesses, from predictive maintenance to the creation of new business models, there is no approach in literature or practice that fully supports businesses in introducing their digital twin, considering their unique requirements and circumstances (Biesinger, 2019; Botín-Sanabria, 2020). The digitalization of tools, procedures and products is becoming more important considering the industrial industry's significant transition and the necessity to profit from the industry 4.0 bonanza. The idea of a digital clone of a real item has been around for ages, but it is about to enter a new era (Botín-Sanabria, 2022; Briggs, 2020). Since its introduction, the digital twin has influenced product lifecycle management, driving dynamic evolution in the industrial sector. The manufacturing industry can now accept the evolving aspects of the digital twin from a variety of fresh perspectives, particularly about the asset and the product. When physical assets like equipment are digitally represented in the manufacturing sector and connected based on their functions, the equipment becomes the supply chain's and the smart factory's connection point. The connected equipment at all levels of this intelligent digital representation's connected system can send and receive data to and from it Bentley Systems (Campos-Ferreira, 2019; Carvalho, 2020). In the meanwhile, operators, maintenance experts, regulatory authorities, and other participating vendors can all read the digital depiction of the equipment, the use cases in the industry are in fig 1.

When a product has digital twins, there are additional advantages, like having complete control throughout the whole life cycle of the product and the ability to change the process if any deviations from the predesigned model occur (Conejos, 2020, Dembski, 2020). In the meantime, it is argued that while the use of digital twins in small-scale industries may initially be hindered by the associated costs and implementation difficulties, it would prove beneficial in all respects in the long term.

The manufacturing sector is now operating differently because of the digital twin. The design of items, as well as their production and upkeep, are significantly influenced by digital twins. Due to its influence, production is more proficient and enhanced, while throughput times are decreasing Erol, T. 2020. Monitoring, tracking, and regulating industrial systems digitally will be made easier by integrating digital twins with industrial enterprises. Since digital twins gather environmental data in addition to operational data, such as location, device settings, and financial frameworks, they have the potential to be powerful tools for predicting future operations and inconsistencies (Evans, 2021; Godager, 2021; Guevara, 2019). This will be an enormous help, particularly in emerging nations like India.

By supporting financial progress, ensuring effective resource management, reducing environmental impact, and increasing the overall value of a resident's life, digital twins and IoT data can improve the planning and construction of a smart city. By extracting visions from multiple sensor networks and smart technologies, the digital twin prototype can help city planners and lawmakers with the design of