

# STRIVING TOWARD A MORE SUSTAINABLE MANUFACTURING VIA DIGITAL TWINS

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## **Abstract:**

Tightening laws and regulations on environmental issues are putting pressure on companies' business and operations (Korhonen et al. 2015). It comes with reasons: according to Mieke et al. (2021), the future of the global economy demands sustainable production, and even though the matter has been the subject of talk for decades, not enough progress has happened. In addition to tightening legislation, companies' sustainability aspects have been a matter of interest among internal and external stakeholders (see, e.g., Gunasekaran and Spalanzani 2012). Hence, if companies aim to stay competitive, they need to implement new management methods to meet their strategic targets while increasing the sustainability of actions (Epstein and Roy 2001), which, on the other hand, requires new tools and techniques (Gunasekaran and Spalanzani 2012). These matters are significant because nowadays, focus on the product is not enough: customers are seeking solutions and buying results instead of mere means of production (Timperi et al. 2023), which, in turn, has powered the role of services in manufacturing industries.

Service business has developed vastly during the ongoing Fourth Industrial Revolution (Industry 4.0 wave), as the revolution has enabled traditional manufacturing practices to coalesce with modern communication and information technologies (Haag and Anderl 2018). At the center of Industry 4.0 is digitalization. It is changing businesses and industries rapidly everywhere and affecting the whole supply chain from producers to end-users and in every step between (Muñoz-Villamizar et al. 2019) by bringing new technologies into the market. One of these technologies is the digital twin (DT), which is argued e.g., by Negri et al. (2017) to be one of the main concepts associated with the Industry 4.0 wave. The DT can have a major impact on supply chains by providing several options to manage data-based decision-making and collaborative environments while enhancing business processes (Marmolejo-Saucedo 2020). A similar observation was made by Mieke et al. (2021), as they stated that "digitalization provides an increasing number of technologies that offer a new perspective on sustainable production, and it especially applies to the concept of digital twins." Thus, the vast growing digitalization and DTs are exciting opportunities to promote more efficient and sustainable business in the manufacturing industry. This research aims to clarify how manufacturing companies can promote sustainable business with different DT solutions, which leads to the following research questions:

*How DT-based manufacturing should be developed from a sustainability perspective?*

*How can DTs promote sustainable business and circular economy along the equipment lifecycle, from the collection of raw materials to the end of the lifecycle and back to raw materials?*

*Can DTs help companies to find concrete ways to reduce the negative impacts of their operations?*

This study is topical because all manufacturing companies must strive towards a more sustainable tomorrow. The research is carried out through a case study in manufacturing industries.

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