

# Chapter 1

## Transforming Consumer Interaction Through Digital Twins and Metaverse in Industry 5.0

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### ABSTRACT

*This study explores how the convergence between digital twins, metaversal platforms, and immersive technologies is transforming consumer interaction in the context of Industry 5.0. From a human-centric perspective, the ethical, technical, and organizational challenges that arise when integrating biometric signals, XR environments, and business models based on affective data are analyzed. The paper examines the need for dynamic organizational capabilities that orchestrate hyper-personalized experiences without compromising privacy, sustainability, or equity. Through a qualitative approach, tensions between innovation, algorithmic*

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*governance and ethical design are identified, proposing a conceptual framework to maximize the experiential and symbolic value of the consumer in advanced socio-technical environments.*

## **INTRODUCTION**

The accelerating convergence between digital twins and immersive metaverse environments has moved from speculative rhetoric to a concrete context in which perception, consumption, and value co creation are being reorganized. Consumer interaction no longer occurs only at the physical point of sale or through a two dimensional ecommerce interface, but inside embodied digital spaces where presence, attention, and feedback become part of the experience design and the market exchange itself (Ranjan & Read, 2021).

Within this landscape, Industry 5.0 is best read as a socio technical project that centers human wellbeing and sustainability as design constraints of manufacturing, rather than as a simple sequential upgrade from prior industrial paradigms. The shift is visible in the way principles, values, and enabling technologies are framed around human centricity, resilience, and responsibility, which forces production systems to negotiate performance together with ethical and social expectations (Ghobakhloo et al., 2023; Hemphill, 2023).

At the operational layer, digital twin driven manufacturing enables tighter coupling between sensing, modeling, and decision cycles, allowing production systems to evolve from static representations toward continuously updated operational intelligence. This is especially consequential when digital twins are integrated with additive manufacturing, because it expands the feasible design space and supports individualized production logics that remain economically viable under high variability (Lu et al., 2020; Jyeniskhan et al., 2024).

In parallel, immersive brand spaces and metaverse touchpoints intensify the logic that value emerges in interaction rather than being embedded in the product alone, which changes how firms think about experience, participation, and the distribution of agency between organizations and users. When immersive environments become persistent, relational, and socially networked, the experience itself becomes the exchange infrastructure through which meanings, identities, and contributions are coordinated (Alexander et al., 2024; Ranjan & Read, 2021).

Yet the promise of scale across platforms depends on governance and interoperability arrangements that can support portability, accountability, and trust without collapsing the diversity of designs into a single centralized gatekeeper. Responsible standards development becomes decisive in preventing fragmentation, aligning safety and transparency expectations, and reducing the risk that technical interoperability

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