


# Chapter 8

## Digital Twin–Enhanced Sentiment Analysis for Targeted Marketing Optimization

**Hamed Nozari**

 <https://orcid.org/0000-0002-6500-6708>

*Independent Researcher, Australia*

**Sepideh Samadi**

 <https://orcid.org/0000-0002-1689-5596>

*Edinburgh Business School, Heriot-Watt University, Dubai, UAE*

### **ABSTRACT**

*This research presents a digital twin-enhanced sentiment analysis model for optimizing targeted marketing strategies using multi-objective optimization. By integrating BERT-based sentiment analysis, digital twin simulation, and evolutionary algorithms, the framework dynamically adjusts marketing actions to maximize engagement, minimize costs, and enhance personalization accuracy. The proposed Greedy Man Optimization Algorithm (GMOA) outperforms traditional methods, achieving superior results in consumer targeting and cost efficiency. Findings demonstrate the effectiveness of AI-driven adaptive marketing, providing a scalable and ethical approach to modern digital advertising.*

DOI: 10.4018/979-8-3693-4369-2.ch008

## 1- INTRODUCTION

The rapid evolution of artificial intelligence (AI), data analytics, and digital transformation has significantly reshaped marketing strategies, enabling businesses to adopt more adaptive, personalized, and data-driven approaches. Traditional marketing methods often rely on historical consumer data and static segmentation, limiting their ability to respond dynamically to evolving customer sentiments. In contrast, real-time insights derived from sentiment analysis and AI-driven models provide a deeper understanding of consumer emotions, allowing businesses to refine their marketing strategies continuously. However, while sentiment analysis offers valuable predictive insights, it lacks the ability to dynamically adjust marketing actions in real time, necessitating an integrated framework that bridges consumer sentiment, behavioral predictions, and decision-making optimization (Abdi et al., 2025).

To address this challenge, this research introduces a digital twin-enhanced sentiment analysis model, where each consumer digital twin acts as a virtual replica of an individual's sentiment, preferences, and past interactions. Unlike traditional static customer profiling, digital twins continuously update based on real-time consumer sentiment fluctuations, enabling a more adaptive and personalized marketing approach. Through this mechanism, businesses can simulate various marketing actions before execution, ensuring that campaigns are optimized for engagement, relevance, and cost-efficiency. However, while digital twins provide a dynamic consumer modeling approach, optimizing multiple conflicting objectives in marketing remains a key challenge, requiring advanced multi-objective optimization techniques to balance engagement maximization, cost efficiency, and personalization accuracy (Movahed et al., 2024 (a)).

This study integrates multi-objective optimization algorithms within the digital twin framework, ensuring that marketing strategies remain adaptive, scalable, and efficient. By leveraging evolutionary algorithms such as NSGA-II, MOEA/D, and the Greedy Man Optimization Algorithm (GMOA), the framework identifies Pareto-optimal solutions that balance competing marketing objectives dynamically (Nozari & Abdi, 2024). The interaction between digital twins and optimization models ensures that consumer sentiment-driven insights directly influence the decision-making process, where optimized marketing actions are updated in real time based on changing consumer behaviors. This seamless integration of AI-driven sentiment analysis, digital twin simulation, and multi-objective optimization enables businesses to maximize consumer engagement while optimizing budget allocations and improving overall marketing effectiveness (Irani et al., 2024).

Beyond performance optimization, ethical compliance is an essential consideration in AI-driven marketing. Ensuring responsible data usage, preventing consumer manipulation, and maintaining transparency are critical for regulatory compliance.

16 more pages are available in the full version of this document, which may be purchased using the "Add to Cart" button on the publisher's webpage: [www.igi-global.com/chapter/digital-twin-enhanced-sentiment-analysis-for-targeted-marketing-optimization/377633](http://www.igi-global.com/chapter/digital-twin-enhanced-sentiment-analysis-for-targeted-marketing-optimization/377633)

## Related Content

---

### Charting the Course of Leadership Through the Digital Era: A Synergy of Leadership Styles, Technology Integration, and Deep Learning

Bayissa Badada, G Delina, Ramaswamy Krishnarajand Michael Moses Thiruthuvanathan (2025). *Leadership Paradigms and the Impact of Technology* (pp. 119-156).

[www.irma-international.org/chapter/charting-the-course-of-leadership-through-the-digital-era/368788](http://www.irma-international.org/chapter/charting-the-course-of-leadership-through-the-digital-era/368788)

### From Township Tourism, Semigration, and Second-Home Tourism: A Reflection on the Migrant Labour System in South Africa

Unathi Sonwabile Henama (2021). *International Journal of Innovation in the Digital Economy* (pp. 1-17).

[www.irma-international.org/article/from-township-tourism-semigration-and-second-home-tourism/273607](http://www.irma-international.org/article/from-township-tourism-semigration-and-second-home-tourism/273607)

### Developing a Decision Model for Selecting the Scripts of Trendy Taiwanese Dramas

Pi-Fang Hsuand Hua-Lin Yang (2020). *International Journal of Innovation in the Digital Economy* (pp. 39-51).

[www.irma-international.org/article/developing-a-decision-model-for-selecting-the-scripts-of-trendy-taiwanese-dramas/262119](http://www.irma-international.org/article/developing-a-decision-model-for-selecting-the-scripts-of-trendy-taiwanese-dramas/262119)

### Managing Crisis Situations Through a Visual Language Communication (VLC) Approach

Eman S. Alkhalifah (2022). *Future Role of Sustainable Innovative Technologies in Crisis Management* (pp. 125-136).

[www.irma-international.org/chapter/managing-crisis-situations-through-a-visual-language-communication-vlc-approach/298935](http://www.irma-international.org/chapter/managing-crisis-situations-through-a-visual-language-communication-vlc-approach/298935)

### Are We There Yet?: An Exploratory Predictive Study of Instructor Acceptance of an Educational Tablet Computer

Stephen Asunka (2016). *International Journal of E-Adoption* (pp. 35-49).

[www.irma-international.org/article/are-we-there-yet/160140](http://www.irma-international.org/article/are-we-there-yet/160140)