Article

Designing the Future of Shopping: An Immersive Simulation Framework for Digital Commerce Strategy and Retail Transformation

Jing Yang [1,*]

[1] Mitch Daniel's School of Business, Purdue University, Indiana, 47907, USA
* Correspondence: Jing Yang, Mitch Daniel's School of Business, Purdue University, Indiana , 47907, USA

Abstract: This paper proposes an immersive simulation framework for digital business strategy and retail transformation. The framework integrates digital twins, scenario factories, and VR/AR/WebXR front ends with in-situ analytics and computational capabilities. Built on a hyperconverged, on-demand, low-latency infrastructure, it supports multiple users while maintaining restricted telemetry. A KPI ontology unifies four critical dimensions: business, operations, experience, and governance. A traceable experimental process-including process traceability, versioned scenarios, and pre-registered metrics-ensures auditability and reproducibility. The framework combines enterprise-level platform practices with evaluation methods from design science research, such as analysis demonstrations, scenario walkthroughs, and Delphi expert reviews, to validate its feasibility. Results demonstrate that the framework achieves orders-of-magnitude acceleration with minimal data movement, significantly reducing offline testing costs and shifting decision-making from traditional "offline A/B testing with local BI" to a "simulation-first approach with closed-loop measurement."

Keywords: immersive simulation framework; digital twin; phygital retail; Design Science Research (DSR)

Received: 11 September 2025
Revised: 20 September 2025
Accepted: 30 October 2025
Published: 08 November 2025

1. Introduction

Digital commerce is entering an era in which strategic choices-such as assortment design, channel orchestration, pricing, and in-store/online experiences-must be rigorously tested in richly contextual, data-driven environments before deployment. An immersive simulation framework can serve as the central instrumentation for this shift. In adjacent domains, immersive simulation has already closed the loop between modeling, measurement, and design steering. Tools that couple in-situ visualization with live, reconfigurable problem definition enable rapid adjustment of quantities of interest and reduce data movement and storage by orders of magnitude-capabilities that are directly applicable to retail strategy exploration, where rapid iteration and constrained telemetry are common [1].

At the level of market experience, retail is increasingly moving toward phygital (physical + digital) hybrids. Recent research synthesizes metaverse and digital-twin technologies into a "sensory-social-value" tri-dimensional framework, explaining how immersive experiences alter consumer decision processes, expand value creation (e.g., digital assets linked to physical goods), and reshape supply chains. This is an architecture that a simulation environment should encode and stress-test [2].

Accordingly, this paper treats immersion as a research instrument rather than a training aid and makes four contributions. First, we architect an immersive simulation framework that integrates digital twins, a scenario factory, and VR/AR/WebXR front ends with in-situ analytics and computational steering on a hyperconverged, pay-as-you-grow foundation. Second, we encode the "sensory-social-value" perspective into a stress-testable scenario library with policy-injection points, such as pricing, replenishment, layout, and BOPIS. Third, we define a KPI ontology that unifies business, operations, experience, and governance metrics, supporting auditable and reproducible workflows through provenance, versioned scenarios, and preregistered measures. Fourth, we outline a Design Science Research evaluation blueprint-including analytical demonstration, scenario walkthroughs, and Delphi/expert review-to assess feasibility and research-grade validity.

We report conditions under which the framework accelerates iteration under constrained telemetry, reduces physical testing costs, and shifts decision-making from traditional "offline A/B testing with local BI" to a "simulation-first approach with closed-loop measurement." The paper concludes with implications, limitations, and deployment guidance.

2. Related Work

2.1. Immersive Simulation, In-Situ Analytics, and Computational Steering

Engineering and scientific computing have increasingly paired high-fidelity simulation with in-situ visualization and computational steering, allowing researchers to reconfigure models and quantities of interest (QoIs) while simulations are running. Newberry et al. propose an immersive simulation software framework that supports live reconfiguration, ensemble compatibility, and substantial reduction of data-at-rest (with reported storage reductions on the order of 10^4-$10^5\times$ for QoI extraction), thereby accelerating design-space exploration without repeated offline post-processing. These systems validate immersion and steering in engineering contexts but rarely address commerce-specific constructs, such as cross-layer KPIs, policy-injection points for pricing, replenishment, or layout, or governance constraints. Our framework addresses this gap by linking steering events to business, operations, and experience metrics.

2.2. Phygital Retail, Digital Twins, and Omnichannel Operations Simulation

On the market and experience side, phygital consumption research integrates metaverse interfaces with digital-twin backends, forming a three-dimensional sensory-social-value lens that explains how immersive experiences reshape consumer decision-making and value realization [2]. We adopt Wang et al.'s review as the experiential lens for simulation scenarios, including virtual try-on, co-presence shopping, and tokenized entitlements linked to physical SKUs. At the enterprise and engineering layer, Renault's ROADS demonstrates how an organization-scale immersive simulation center integrates digital twins, a "scenario factory," and mixed-reality rigs to validate complex behavior before physical prototyping, providing evidence that immersive and twin stacks can be operationalized at scale [3]. We analogize this template to retail labs, which combine virtual stores, agent-based shoppers, and live ERP/TMS twins for policy validation.

In operations, the Winter Simulation Conference literature documents decades of discrete-event and agent-based models for picking, order consolidation, and capacity planning, forming core building blocks for omnichannel strategies such as BOPIS and click-and-collect [4]. Recent conceptual work in in-store immersive retailing further motivates linking spatial experience design to behavioral and performance outcomes, which our framework operationalizes through scenario libraries and cross-layer KPIs [5]. Although the phygital/digital-twin and omnichannel simulation literatures are extensive, they are typically decoupled: immersive UX studies seldom expose policy levers for inventory, pricing, or fulfillment, and logistics simulations rarely model embodied experience or governance considerations, such as fairness or privacy.

2.3. Simulation as a Research Instrument and Design-Science Evaluation

Because our goal is strategy research rather than training, we align with the "simulation-as-research-instrument" paradigm from healthcare simulation. Munroe et al. specify requirements for fully immersive scenarios used as research tools, including exclusion of instructional intent, enforcement of standardized scenario design and validation, and documentation of development and technical instructions to safeguard validity and reliability [6]. We consider Delphi or structured expert review a suitable ex-ante evaluation method when field experiments are infeasible. Prior design-science research rarely addresses immersive, multi-layer retail twins with explicit governance considerations, such as fairness in dynamic pricing or privacy-preserving telemetry. We contribute an evaluation blueprint that combines analytical justification, scenario-based walkthroughs, and expert consensus, introducing research-grade rigor to immersive retail strategy simulations.

3. Related Work

3.1. Immersive Simulation, In-Situ Analytics, and Computational Steering

Engineering and scientific computing have increasingly paired high-fidelity simulation with in-situ visualization and computational steering, enabling researchers to reconfigure models and quantities of interest (QoIs) while simulations are running. Newberry et al. propose an immersive simulation software framework that supports live reconfiguration, ensemble compatibility, and dramatic data-at-rest reduction (reported storage reductions on the order of 10^4-$10^5\times$ for QoI extraction), thereby accelerating design-space exploration without repeated offline post-processing. Work on provenance and user-action tracking in dynamic computational workflows, such as logging steering actions and their causal impact on results, provides concrete mechanisms for auditability and repeatability. We incorporate these mechanisms into immersive commerce simulations to support research-grade claims. While these systems validate immersion and steering in engineering contexts, they rarely address commerce-specific constructs, including cross-layer KPIs, policy injection points for pricing, replenishment, layout, or governance constraints. Our framework addresses this gap by linking steering events to business, operations, and experience metrics.

3.2. Phygital Retail, Digital Twins, and Omnichannel Operations Simulation

From the market and experience perspective, phygital consumption research integrates metaverse interfaces with digital twin backends, forming a three-dimensional sensory-social-value lens that explains how immersion reshapes consumer decision-making and value realization. At the enterprise and engineering level, Renault's ROADS demonstrates how an organization-scale immersive simulation center integrates digital twins, a "scenario factory," and mixed-reality rigs to validate complex behavior before physical prototyping, showing that immersive and twin stacks can be operationalized at scale. We analogize this template to retail labs, which combine virtual stores, agent-based shoppers, and live ERP/TMS twins for policy validation. These studies also provide validated queueing and flow primitives, such as labor-intensive picking, shift planning, and service-time calibration, which we reuse as mechanistic submodels under immersive front ends.

3.3. Simulation as a Research Instrument and Design-Science Evaluation

Because our goal is strategy research rather than training, we adopt the "simulation-as-research-instrument" standards from healthcare simulation. Munroe et al. specify requirements for fully immersive scenarios used as research tools, including exclusion of instructional intent, enforcement of standardized scenario design and validation, and documentation of development and technical procedures to ensure validity and reliability. We apply these controls to retail by fixing demand shocks, scripting social influence, preregistering KPIs, and maintaining scenario versioning. Prior design-science research rarely addresses immersive, multi-layer retail twins with explicit governance considerations, such as fairness in dynamic pricing or privacy-preserving telemetry. We contribute an evaluation blueprint that combines analytical justification, scenario-based walkthroughs, and expert consensus, introducing research-grade rigor to immersive retail strategy simulations.

4. Conceptual Framework & Architecture

4.1. Actors & Environments

In the immersive retail simulation system, we define the key "actors" and their "environments" to represent both operational and experiential dimensions of digital commerce. As illustrated in Figure 1, the framework models emerging concepts such as metaverse retail and virtual shopping, demonstrating how diverse roles interact across physical and digital layers to simulate the full consumer journey [7].

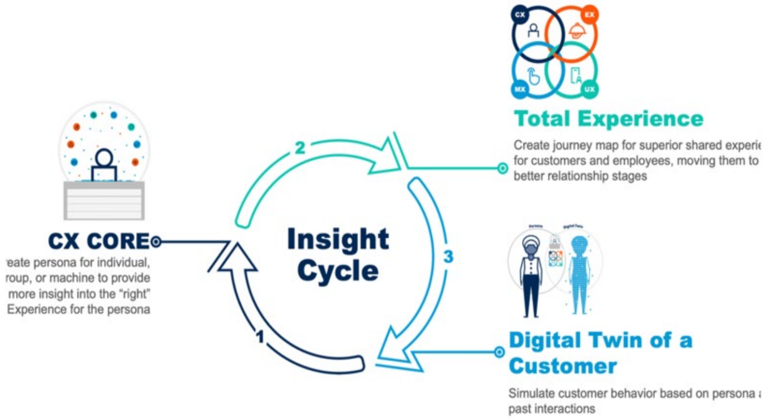

Figure 1. Immersive Strategy Simulation Loop for the Future of Shopping.

Consumers: They navigate apps, virtual stores, and physical outlets, performing actions such as browsing, virtual try-on, purchasing, and returning items. Virtual shopping platforms provide "3D immersive malls" where users can interact with products through gestures or haptic feedback, significantly extending engagement time and conversion rates [CSDN, 2025].

Virtual Sales Associates/Staff: AI-driven or avatar-based assistants provide personalized consultations, product explanations, and remote support [8]. They replicate the role of in-store associates within immersive spaces, guiding users through layouts or product demonstrations in real time.

Fulfillment Nodes (Warehouses and Stores): Each node manages inventory, replenishment, and picking tasks, acting as both physical and digital twin components within the simulation.

Couriers / Delivery Agents: Represent the logistics layer connecting online orders to physical delivery, capturing factors such as route optimization, delay probability, and delivery-time variance.

Customer Service Agents: Handle after-sales interactions and technical support. In immersive environments, AR/VR support allows remote assistance-for example, customers upload an image of a malfunctioning appliance, and virtual engineers annotate repair steps in 3D.

Policy Agents: Represent decision modules-including pricing, replenishment, planogram layout, and BOPIS (Buy Online, Pick-Up in Store) dispatch-responsible for injecting strategic adjustments into the simulation.

Platform Algorithms: Recommendation and search systems determine which products the customer sees and their ranking, influencing both exposure and purchase probability.

Channel Layer: The multi-entry space for interaction, including mobile apps, mini-programs, VR stores, and physical outlets. These correspond to the "seamless omnichannel" vision, where transitions between browsing, try-on, and checkout are frictionless.

Supply Chain Network: Connects warehouses, stores, and consumers through real-time inventory and logistics simulation.

Last-Mile Topology: Models couriers, delivery hubs, and lockers for local distribution and pick-up coordination.

Immersive Space (VR/AR/WebXR): A spatial digital environment that integrates sensory, social, and commercial interactions. It reconstructs retail experiences such as virtual malls, thematic product zones, or brand storytelling environments, transforming shopping into a social and exploratory act rather than a purely transactional one.

To support seamless omnichannel and immersive experiences, most systems utilize a hybrid communication environment combining HTTP-based synchronous exchanges with WebSocket-based real-time streams. As shown in Figure 2, user actions within the immersive browser interface (VR/AR/WebXR) are transmitted through a Web/WebSocket server interface layer that handles both request-response (HTTP) and event-driven (WebSocket) communication [9]. The Channel (ASGI) layer coordinates message passing between consumers and backend workers, enabling responsive updates such as virtual try-on rendering, inventory refresh, or real-time agent assistance. This architecture ensures low-latency synchronization between customer interactions, simulation updates, and analytics dashboards, which is essential for immersive retail environments.

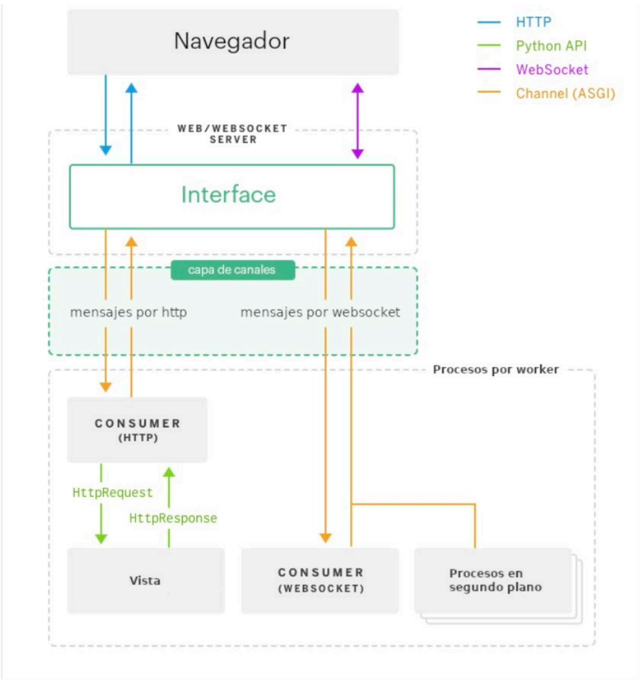

Figure 2. Real-Time Interaction Environment for Immersive Retail Simulation.

4.2. Layered Architecture & Data / Control Flows

The architecture supporting the immersive retail simulation is designed as a scalable, modular, and hyper-converged system that integrates computation, storage, and network resources under a single software-defined layer. As shown in Figure 3, traditional multi-tier infrastructures rely on separately managed servers, network switches, and storage arrays, often resulting in integration overhead and latency in data synchronization between simulation models, analytics dashboards, and immersive visualization modules. In contrast, a converged infrastructure (CI) aggregates these components into a pre-configured, centrally managed system, reducing deployment time and improving compatibility across hardware layers [10]. This design allows the simulation platform to dynamically allocate resources to high-load processes-such as real-time 3D rendering or agent-based modeling-while maintaining low latency for multi-user interactions across VR/AR and WebXR channels.

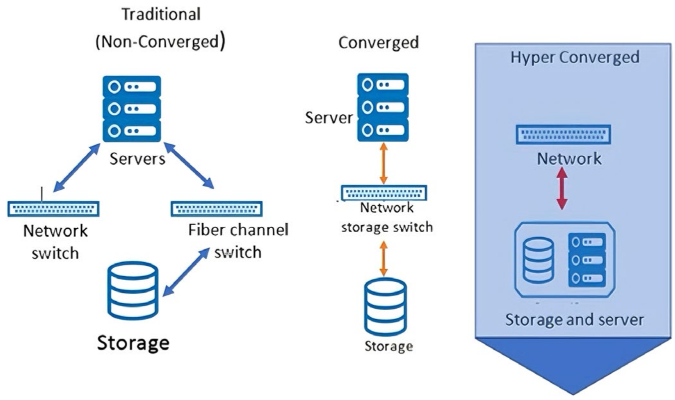

Figure 3. From Traditional to Hyper-Converged Infrastructure for Immersive Simulation.

The figure visualizes traditional, converged, and hyper-converged infrastructure layers and their respective integration levels. Building on this architecture, each simulation instance operates as a distributed workload across multiple virtual nodes, integrating orchestration, policy control, and analytics pipelines into a seamless operational loop. Data and control messages traverse both synchronous HTTP interfaces and asynchronous WebSocket streams, as introduced in Section 3.1, ensuring that every actor interaction-such as inventory updates, customer digital twin responses, or pricing adjustments-is propagated in real time across all subsystems. The convergence of these functions within a shared virtualization fabric not only minimizes cross-layer latency but also supports elastic scaling for complex retail scenarios requiring thousands of concurrent agent updates and immersive feedback events.

As illustrated in Figure 4, the framework adopts a "pay-as-you-grow" scaling strategy similar to enterprise hyper-converged infrastructure solutions. Each additional simulation or analytics node expands both compute and storage capacity linearly, avoiding the costly over-provisioning typically associated with monolithic systems [11]. This elasticity allows research teams or retail operators to conduct small-scale experiments-such as evaluating a single promotional strategy or testing a new virtual store layout-and then scale out to city- or nationwide simulations without architectural modifications. Additionally, software-defined resource pooling simplifies governance and cost allocation, as usage can be metered per scenario or department, ensuring efficient energy consumption and supporting sustainable digital commerce operations. Overall, the adoption of a hyper-converged, pay-as-you-grow architecture transforms the immersive retail simulation platform into a resilient, flexible, and economically scalable environment that supports real-time strategy experimentation and retail transformation.

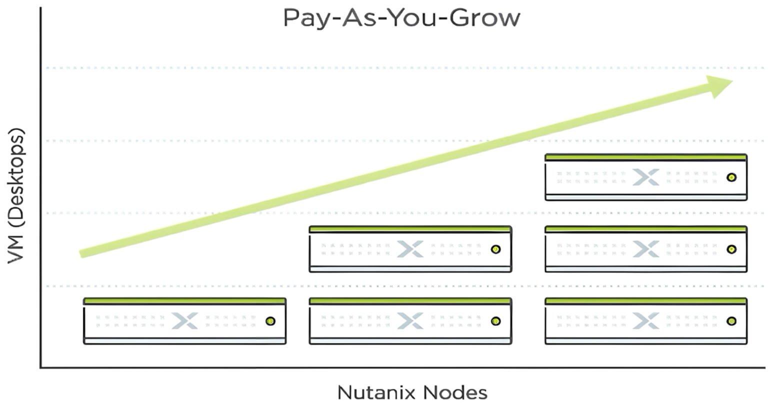

Figure 4. Elastic Scaling in a Pay-As-You-Grow Architecture.

4.3. KPI Ontology and Measurement

In the context of immersive retail simulation, Key Performance Indicators (KPIs) function as the semantic bridge connecting digital operations, business strategy, and customer experience. Drawing on data-driven management frameworks from digital transformation research, the proposed KPI ontology organizes multi-domain metrics into a unified knowledge layer that links business objectives, operational performance, and experiential immersion. Traditional retail metrics often remain siloed-sales KPIs separated from logistics or user-experience analytics-making it challenging to evaluate system-wide trade-offs. As shown in Table 1, the ontology explicitly specifies not only how each KPI is calculated but also how it relates to real-world processes-for example, Customer Lifetime Value (CLV) depends on repeat-purchase trajectories modeled within the Customer Digital Twin, while On-Time In-Full (OTIF) reflects synchronization between warehouse simulation and courier scheduling. This approach elevates KPI measurement from passive reporting to an active decision-support mechanism embedded within the immersive retail simulation loop.

Table 1. KPI Taxonomy with Definitions and Units (Simplified).

Category	Indicator	Definition	Unit	Sampling	Desirable Trend
Business	GMV (Gross Merchandise Volume)	Total transaction value within a given time window	USD	Daily / Weekly	↑
	CVR (Conversion Rate)	Ratio of purchases to total visits	%	Real-time	↑
Operational	Stockout Rate	Percentage of unavailable SKUs during demand	%	Real-time	↓
	OTIF (On-Time In-Full)	Proportion of orders delivered as promised	%	Per batch	↑
Experience / Immersion	Interaction Success Rate	Successful VR/AR interactions vs. total attempts	%	Real-time	↑
	Motion-to-Photon Latency	Delay between user action and visual response	ms	Continuous	↓

NPS (Net Promoter Score)	User satisfaction and likelihood of recommendation	Score	Monthly	↑

As shown in Table 1, the proposed KPI taxonomy summarizes representative metrics, their definitions, and measurement logic. Collectively, these metrics provide a concise yet comprehensive framework for evaluating both commercial performance and experiential outcomes in immersive retail strategy simulations. This structure enables dynamic feedback loops, where strategy adjustments immediately influence KPI trajectories, and variations in KPIs guide subsequent optimization cycles.

5. End-to-End Case Study: Retail Digital Twin and Immersive Simulation for Omnichannel

5.1. Overview of the Immersive Retail Twin Framework and Its Relevance

The Immersive Retail Twin Framework (IRTF) represents a large-scale, data-driven simulation environment designed to optimize omnichannel retail operations. Its architectural principles-digital twin layering, scenario factory design, and continuous in-loop validation-enable real-time coordination among stores, warehouses, logistics systems, and customer-facing platforms.

1) At the core of the IRTF lies a multi-layer twin structure:
2) Physical layer: Corresponds to tangible retail assets, including brick-and-mortar stores, distribution centers, delivery vehicles, and customer devices.
3) Digital layer: Mirrors these entities as continuously updated virtual twins, incorporating transaction logs, sensor telemetry, and customer interaction data from both physical and online channels.
4) Analysis layer: Integrates behavioral telemetry and KPI-driven analytics to assess operational performance and customer experience outcomes in real time.

This tri-layer structure ensures that pricing, replenishment, layout, and staffing strategies can be tested safely in a virtual environment before physical deployment, allowing retailers to evaluate risk and return on investment under controlled, repeatable conditions. Analogous to how the ROADS platform validated autonomous driving performance before real-world deployment, IRTF enables retailers to conduct "autonomous retail" experiments, in which algorithmic decisions on product placement, delivery routing, or service capacity are simulated and validated within immersive digital environments. IRTF inherits ROADS's concept of scalable automation maturity, reflecting the challenge of maintaining operational reliability with minimal human intervention.

5.2. Mapping ROADS Concepts to Immersive Retail Simulation

While originally applied in mobility and transportation, the ROADS digital twin paradigm provides transferable architectural logic for immersive retail simulation. In ROADS, coordination among physical vehicles, communication nodes, and digital controllers ensures safe and adaptive operations. In retail, these principles translate to real-time coordination among shoppers, stores, warehouses, and online platforms.

The software-defined, reconfigurable ROADS architecture aligns closely with cloud-edge retail systems (see Table 2). In retail environments, edge servers within stores dynamically allocate computing resources for vision analytics, demand prediction, and immersive rendering, while cloud controllers handle global model synchronization and strategic decision-making. This parallels how ROADS adapts to fluctuating communication loads and spatial traffic conditions, except that in retail, "traffic" refers to consumer flow rather than vehicles.

Table 2. Conceptual Mapping Between ROADS Simulation Architecture and Retail Twin Analog.

ROADS Concept	Retail Twin Analogue
Vehicle communication nodes	Shopper agents, order requests, and inventory updates
Road topology	Store layout, shelf network, and customer navigation paths
Signal processing nodes	Edge computing units managing checkout, queue control, and AR rendering
Bandwidth allocation	Data pipeline balancing between transaction streams, video analytics, and IoT telemetry
Multi-level automation	AI-driven decision layers for replenishment, pricing, and personalized recommendations

System integration embeds these insights into live enterprise platforms such as ERP, CRM, and fulfillment systems, enabling virtual experiments to directly validate operational policies. Continuous optimization closes the loop: KPI feedback and AI-assisted scenario replays iteratively refine pricing, replenishment, and layout strategies. Collectively, these stages operationalize a self-learning simulation ecosystem in which every decision becomes measurable, auditable, and improvable through immersive experimentation.

5.3. Evaluation and Lessons for Retail Transformation

The IRTF case demonstrates that immersive digital twins can substantially reduce experimentation costs and shorten strategic decision cycles in retail environments. By integrating 3D simulation, AI-based forecasting, and live KPI monitoring, the framework allows retailers to test store layouts, promotional campaigns, and inventory policies virtually before physical implementation, mirroring how ROADS validated driving behavior prior to deployment. For example, a major grocery chain used IRTF to simulate store traffic flow during peak hours, testing multiple shelf configurations and BOPIS (Buy Online, Pick-Up In Store) scheduling policies.

By embedding real-time KPIs, such as Conversion Rate (CVR), On-Time In-Full (OTIF), and Net Promoter Score (NPS), into the simulation dashboard, retail managers can visualize the cascading effects of operational changes across the entire omnichannel network. For instance, a pricing adjustment simulated in one store automatically propagates through the virtual logistics model, revealing downstream effects on warehouse load, delivery latency, and gross margin. Marketing teams can evaluate campaign impact on store traffic, supply chain managers can monitor fulfillment efficiency, and IT engineers can tune rendering latency to ensure smooth VR experiences. All participants operate within a shared digital space, eliminating communication silos and creating a unified, data-driven decision-making environment.

In summary, lessons from ROADS demonstrate that predictive sensing, real-time simulation, and continuous feedback are as transformative in retail as they are in mobility. Implementing these principles allows retailers to build agile, resilient, and customer-centric ecosystems, transforming traditional operations into immersive, intelligent, and adaptive retail networks.

6. Conclusion

This study systematically demonstrates the feasibility and necessity of immersive simulation as a central instrument for retail strategy. By establishing a closed-loop coupling among physical spaces, digital twins, and analytical layers, the framework leverages in-situ analytics and computational steering to guide interactive strategy exploration and provide immediate feedback. Using a KPI ontology, it unifies cross-layer objectives-such as GMV/CLV, OTIF/out-of-stock rate, immersive interaction success rate/motion-to-photon latency, fairness, and privacy compliance-into a computable contract, enabling the joint optimization of experience design, operational policies, and supply chain mechanisms under a consistent metric semantics.

Looking ahead, future developments will progress along three key directions. First, the framework will deepen the two-way integration with production systems (ERP, OMS, WMS, CRM, and recommendation engines), incorporating federated learning and differential privacy to support privacy-preserving telemetry across stores and channels. Second, it will establish open benchmarks and reproducible pipelines, release standardized scenario libraries and reference implementations, and promote the evaluation of trade-offs and governance guardrails-including price fairness, privacy, and bias monitoring-within multi-objective optimization encompassing revenue, experience, energy consumption, fairness, and compliance. Third, the system will enhance human-machine collaborative strategy agents and expert co-creation processes (e.g., Delphi and structured review), advancing immersive simulation from an internal enterprise capability to an industry-shared "strategy middle platform."

As these elements mature, retail decisions can be iteratively refined in a closed loop between simulation and real-world networks, forming a new generation of digital business operating systems characterized by immersive measurement, rapid stress testing, and robust implementation. This paradigm promises to transform retail strategy, enabling agile, resilient, and evidence-driven decision-making at scale.

References

1. F. Newberry, C. Wetterer-Nelson, J. A. Evans, A. Doostan, and K. E. Jansen, "Software tools to enable immersive simulation," *Engineering with Computers*, vol. 38, no. 5, pp. 4697-4713, 2022. doi: 10.31224/osf.io/mrf5d
2. A. H. Rafi, "The Impact of Artificial Intelligence on Customer Experience in E-commerce Platforms," *International Journal of Technology, Management and Humanities*, vol. 9, no. 04, pp. 118-136, 2023.
3. A. A. Detoni, G. M. Miranda, L. D. Renault, R. A. Falbo, J. P. A. Almeida, G. Guizzardi, and M. P. Barcellos, "Exploring the role of enterprise architecture models in the modularization of an ontology network: a case in the public security domain," In *2017 IEEE 21st International Enterprise Distributed Object Computing Workshop (EDOCW)*, October, 2017, pp. 117-126.
4. L. Lang, L. Chwif, and W. Pereira, "Decision-making impacts of originating picking waves process for a distribution center using discrete-event simulation," In *2022 Winter Simulation Conference (WSC)*, December, 2022, pp. 1509-1520. doi: 10.1109/wsc57314.2022.10015343
5. R. Rahmani, C. Jesus, and S. I. Lopes, "Implementations of Digital Transformation and Digital Twins: Exploring the Factory of the Future," *Processes*, vol. 12, no. 4, p. 787, 2024. doi: 10.3390/pr12040787
6. C. C. Dosoftei, "Simulation power vs," immersive capabilities: enhanced understanding and interaction with digital twin of a mechatronic system. Applied Sciences, vol. 13, no. 11, p. 6463, 2023.
7. N. A. Assimakopoulos, and A. Miaris, "Viable system dynamics intelligent framework for assessing and optimizing systemic reengineering for e-governance environments: A case study in corfu sunspots tourist agency," *Acta Europeana Systemica*, vol. 7, pp. 17-30, 2017.
8. K. Nolan, "VR SuperGun: Installation Edition," In *Proceedings of the Eighteenth International Conference on Tangible, Embedded, and Embodied Interaction*, February, 2024, pp. 1-3. doi: 10.1145/3623509.3635324
9. S. A. Azeem, and S. K. Sharma, "Study of converged infrastructure & hyper converge infrastructre as future of data centre," *International Journal of Advanced Research in Computer Science*, vol. 8, no. 5, pp. 900-903, 2017.
10. S. Halabi, "Hyperconverged infrastructure data centers: demystifying HCI," *Cisco Press*, 2019.
11. J. Chen, X. Zhang, Y. Wu, S. Ghosh, P. Natarajan, S. F. Chang, and J. Allebach, "One-stage object referring with gaze estimation," In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, 2022, pp. 5021-5030.