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Industry 4.0-enabled Customer-Centric Supply Chain Processes in Creative Industries: A Meta-Synthesis Framework

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ABSTRACT

Objective: This study addresses the critical gap in understanding how Industry 4.0 technologies—Artificial Intelligence (AI), Internet of Things (IoT), blockchain, and Extended Reality (XR)—synergistically transform customer-centric supply chains in creative industries (e.g., music, fashion, film). It moves beyond fragmented analysis to develop a unified framework for customer-integrated value delivery.

Methodology: A systematic meta-synthesis was conducted following established seven-stage protocols. A targeted search across Scopus and Web of Science (2016–2025) identified relevant literature. After stringent screening and quality appraisal (the Critical Appraisal Skills Programme (CASP) checklist), 59 high-quality publications were analyzed through iterative coding and thematic analysis.

Results: The analysis produced a novel framework of five interdependent components: (1) *Customer-Integrated Value Creation* (e.g., AI co-design), (2) *Omnichannel & Immersive Fulfillment* (e.g., XR commerce), (3) *Dynamic Value Capture Models* (e.g., fan-driven financing), (4) *Algorithmic & Gamified Community Engagement*, and (5) *Networked Co-Creation Ecosystems*. The framework demonstrates how AI, IoT, blockchain, and XR interconnect to transform linear supply chains into agile, experiential, community-integrated value networks.

Conclusion: This study presents the first synthesized framework for Industry 4.0-enabled, customer-centric supply chains in creative industries. It bridges technology, culture, and operations management, offering researchers a structured model for future inquiry and providing practitioners with a strategic roadmap for building responsive, community-driven operations. The research fills a significant literature gap and offers a blueprint for competitive advantage in the digital creative economy.

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Introduction

The advent of the Fourth Industrial Revolution (Industry 4.0) has fundamentally reconfigured the logic of economic value creation, exchange, and consumption (Li et al., 2021). More than a mere set of tools, the cyber-physical integration enabled by artificial intelligence, the Internet of Things, and advanced data analytics has dissolved traditional boundaries between the physical and digital realms, reshaping the very fabric of production and service delivery (Haldorai, 2023). This transformation is particularly pronounced and paradoxical within the creative industries—encompassing music, fashion, film, design, and gaming. In these sectors, the intangible essence of cultural and artistic meaning must coexist and synergize with the tangible, data-driven logic of intelligent systems (Safavi & Ghazinoory, 2025). This convergence has given rise to a new operational reality for creators and cultural enterprises, where traditional, linear models of value delivery are being rapidly supplanted by the demand for highly personalized, interactive, and experiential engagement (Nasta, 2025).

Consequently, the core operational challenge for creative enterprises in the digital era shifts from mere product promotion to orchestrating a customer-centric downstream supply chain (Kang et al., 2024). This supply chain transcends traditional logistics; it is a dynamic, value-generating network that manages the flow of not only physical goods and digital assets but also—and more critically—experiences, data, and community interactions. It requires synchronizing customer-driven creation (co-design, NFTs), agile fulfillment (omnichannel distribution, on-demand production), and post-transaction engagement (immersive experiences, community building) into a seamless, responsive system (Yuan & Du, 2025). Excelling in this new paradigm is not a mere option but an operational imperative for sustainability and growth in the creative economy.

This profound digital shift has been recognized as a catalyst for rethinking value delivery mechanisms, moving from standardized processes toward adaptive, customer-integrated models. These models are characterized by mass customization, continuous experiential relationships, and dynamic reconfiguration of operations (Guendouz, 2023; Dash et al., 2021). A growing body of research documents the disruptive impact of specific Industry 4.0 technologies on various facets of creative practice: AI in generative art and music, blockchain through NFTs transforming ownership and royalties, and extended reality enabling immersive try-on and concert experiences (Rani, 2025; Clarencia et al., 2024; Malik et al., 2023). Concurrently, scholarship highlights the rise of the "cultural entrepreneur," who must strategically navigate the "market for meaning" by leveraging digital platforms not only for distribution but also for building community and fostering direct audience participation (Lockwood et al., 2025; Abduh et al., 2024; Chang et al., 2021).

However, despite its richness, this expanding corpus of knowledge presents a fragmented academic landscape. While deep, vertical insights exist into individual technologies or specific

creative sub-sectors, a critical horizontal synthesis is absent. The literature remains siloed, offering pieces of a puzzle rather than a complete picture. Consequently, there is a lack of a coherent, unified theoretical model to explain how the disparate, technology-driven elements of customer-centric operations—such as intelligent co-creation, dynamic value capture, decentralized fulfillment, immersive interaction, and community ecosystems—interrelate and function as an integrated whole. This gap is especially critical within the context of creative industries, where success hinges on emotional resonance, symbolic depth, and participatory experiences that generic operational frameworks fail to address.

To address this gap and move from fragmentation to synthesis, this paper undertakes a systematic meta-synthesis of scholarly literature published between 2016 and 2025. Through rigorous analysis and integration of findings from 59 selected studies, identified via a stringent screening protocol, this research constructs a holistic framework. Its primary objective is to identify, categorize, and synthesize the core dimensions that collectively constitute Industry 4.0-enabled customer-centric supply chain processes as an integrated system specifically for the creative industries. This methodological approach transforms fragmented observations into a structured, actionable model that clarifies the architecture of contemporary value delivery in the cultural economy.

The remainder of this paper is structured as follows. First, a critical literature review establishes the foundational concepts of Industry 4.0, the distinctive nature of creative industries, and the evolution toward customer-centric operations. This is followed by a detailed description of the seven-stage meta-synthesis methodology employed. The results section then presents the core output of the research: a derived multi-component framework that defines the key axes of customer-centric supply chain processes in creative sectors. Finally, the discussion articulates the theoretical contributions and practical implications of the framework, providing a coherent lens to guide future research and strategic practice in the evolving creative economy.

Literature Background

1. The Evolution of Supply Chain Management in the Industry 4.0 Era

The dawn of the 21st century has heralded a paradigm shift in industrial production and economic organization, known as the Fourth Industrial Revolution or Industry 4.0. Originating in manufacturing, this paradigm is characterized by the cyber-physical integration of production systems, where smart machines, storage systems, and production facilities autonomously exchange information, trigger actions, and control each other independently (Abikoye et al., 2021). The core enablers—the Internet of Things (IoT), Big Data analytics, Artificial Intelligence (AI), cloud computing, additive manufacturing, augmented and virtual reality (AR/VR), and blockchain—have transcended factory floors to fundamentally restructure value chains and reengineer customer

interactions across all sectors (Rane, 2023). Consequently, Supply Chain Management (SCM) is undergoing a co-evolution into "smart" or "digital supply chains," a transformation driven by the deep integration of these technologies into core SCM functions, reshaping logistics, demand forecasting, customer integration, and end-to-end visibility (Dash et al., 2021; Malik et al., 2023).

Traditional, linear supply chain models are inadequate in this hyper-connected, data-saturated environment. Industry 4.0 enables a strategic shift from supply-push to demand-pull dynamics, from standardized logistics to mass-customized fulfillment, and from centralized control to decentralized, participatory value networks (Aheleroff et al., 2021). This evolution demands a reconceptualization of SCM within technologically intensive ecosystems. Every element of the downstream supply chain is being reconfigured. Smart Products and Services become dynamic, context-aware nodes within the supply network. Embedded with sensors and connectivity, they generate continuous data streams that enable real-time adaptation, predictive maintenance, and co-creative customization, transforming them from static inventory units into interactive platforms for customer engagement (McColl-Kennedy et al., 2025). Pricing and Revenue Management strategies are revolutionized by AI-driven dynamic and participatory models that respond in real-time to micro-variations in demand, competitive actions, and individual customer willingness-to-pay, thus becoming an integrated function of agile SCM (Annarita et al., 2023). Distribution and Fulfillment (Place) evolve into smart, omnichannel ecosystems. IoT-enabled logistics, autonomous vehicles, and blockchain-based digital marketplaces facilitate direct, transparent, and traceable producer-to-consumer flows, enabling seamless "phygital" customer journeys and reducing transaction costs (Faccia et al., 2023).

Customer integration and communication within the supply chain are profoundly disrupted. Big Data analytics and AI empower hyper-personalized engagement, moving beyond mass advertising to contextually relevant, behavioral interactions rooted in real-time supply chain data. Furthermore, SCM strategies increasingly leverage co-creational frameworks, where customers participate not just as end-users but as active contributors to product design, content creation, and supply chain storytelling—a shift enabled by digital platforms that turn customers into prosumers within the value network (Pizzolitto, 2024; Gamble & Gilmore, 2013). This evolution points towards entrepreneurial and adaptive supply chain management, where competitive advantage depends on an organization's agility, innovation, and ability to fuse technological capabilities with deep customer insight for superior responsiveness (Abduh et al., 2024).

Underpinning this new supply chain paradigm is data as the foundational asset. The pervasive capture and analysis of behavioral, transactional, operational, and social data fuel the adaptive intelligence of supply chain systems, enhancing dynamic capabilities for sensing demand shifts, mitigating risks, and reconfiguring resources with unprecedented speed (Zong et al., 2025; Dash et al., 2021). However, this raises critical SCM challenges regarding data sovereignty, ethical AI in

logistics, and algorithmic bias in demand planning. The supply chain manager's role thus expands to include data scientist, network orchestrator, and ethics steward. This comprehensive technological and strategic shift forms the essential backdrop for understanding the specific transformations within the creative industries' supply chains (Hemker et al., 2021).

2. Creative Industries in the Industry 4.0 Era: A Supply Chain Perspective

The creative industries, encompassing music, fashion, film, design, gaming, and cultural tourism, are defined by their reliance on symbolic production, cultural meaning, and artistic labor. Historically, these sectors have been early adopters of new media and expressive tools, making the intersection of digital transformation and creative production a fertile ground for supply chain innovation (Dash et al., 2021). Industry 4.0 technologies are not merely new tools but disruptive forces that reshape the entire creative supply chain, from ideation and production to distribution, consumption, and post-consumption engagement, thereby restructuring the entire creative ecosystem (Malik et al., 2023).

A central theme in the contemporary landscape is the entrepreneurial shift in creative supply chain orchestration. The figure of the "entrepreneurial artist" has emerged, who must act as a supply chain architect—managing digital branding, direct-to-fan distribution, community engagement, and funding—responsibilities analogous to those of a startup founder within innovation ecosystems (Win, 2014). This shift, intensified by changing models of public support, blurs the lines between creative practice and market-driven supply chain innovation, demanding new professional skill sets in digital SCM (Abduh et al., 2024). This entrepreneurialism operates within the "supply chain for meaning," a model where cultural production involves the creation, entrepreneurial discovery, and institutionalization of cultural meanings across a global digital network (Chang et al., 2021). Creative products gain economic traction through the strategic mediation of meaning, a process increasingly dependent on digital communication technologies, real-time audience feedback loops, and agile global distribution infrastructures (Nasta, 2025).

In the upstream (production) segment of the creative supply chain, digital tools and AI have democratized and augmented creativity. AI-powered generative models (GANs, CNNs) are streamlining creative workflows in design, visual effects, and music, acting as collaborative agents that enhance efficiency and enable novel aesthetic outputs, thus altering traditional production schedules and resource planning (Clarencia et al., 2024). However, this raises significant ethical SCM concerns regarding authenticity verification, intellectual property (IP) tracking, and the nature of digital authorship (Win, 2014). Midstream (distribution and access) has been radically platformized and, potentially, decentralized. While dominant digital platforms (e.g., streaming services, app stores) create new oligopolistic dynamics and amplify "superstar effects" through algorithmic curation—acting as powerful intermediaries in the supply chain (Pizzolitto, 2024; Malik et al., 2023)—blockchain technology offers a counter-model for SCM. By enabling NFTs,

smart contracts, and decentralized autonomous organizations (DAOs), blockchain promises to disintermediate traditional channels, enhance royalty transparency through immutable ledgers, and create novel forms of digital asset ownership and provenance tracking, despite associated risks like volatility and accessibility barriers (Clarencia et al., 2024; Malik et al., 2023).

The downstream (consumption and engagement) segment is becoming deeply immersive and interactive, representing the customer-facing frontier of the creative supply chain. The Internet of Things (IoT) enables smart wearables, connected venues, and sensor-based installations that create responsive environments, blurring boundaries between creators and audiences and generating valuable consumption data (Kay & Polonsky, 2010). Extended Reality (XR) technologies allow consumers to virtually try on fashion, attend immersive concerts, and explore narrative worlds, transforming passive consumption into active, sensory-rich experiences that extend the product-service ecosystem (Thimm, 2014). This aligns with the understanding that value in creative supply chains is co-created through sensory, affective, and cognitive processes shared between the producer and the consumer (Kay & Polonsky, 2010).

3. Managing Downstream, Customer-Centric Supply Chain Processes in Creative Industries

Managing supply chain processes within creative industries has always differed from traditional sectors due to the core reliance on emotional resonance, symbolic differentiation, and experiential engagement as key deliverables. Value creation strategies are inherently tied to narrative identity, aesthetic value, and cultural symbolism (Dash et al., 2021; Thimm, 2014). Industry 4.0 technologies do not replace these fundamentals but provide powerful new mechanisms to execute and deepen them, leading to the emergence of smart, customer-centric supply chain processes specific to creative domains. This approach is characterized by the integration of technological, cultural, experiential, and strategic dimensions across the supply network (Rosário and Dias, 2022).

3.1. From Promotion to Immersive Co-Creation and Experiential Fulfillment

In creative SCM, customer engagement is increasingly inseparable from the product-service experience itself, becoming a critical component of downstream fulfillment. Immersive Technologies (XR) transform traditional touchpoints into experiential portals, using AR for virtual try-ons or VR for product previews, thereby driving engagement and reducing return rates in fashion, for instance (Gursoy et al., 2023). This leverages the core SCM principle that consumer perceptions of authenticity and experience co-creation are pivotal to satisfaction and loyalty (Muniz & Guzman, 2023). Furthermore, supply chain strategies now systematically harness co-creational frameworks. Digital platforms facilitate various tiers of participation—from user-generated content to prosumer innovation—where consumers actively shape product evolution and brand narratives. This represents a fundamental power shift in the supply chain, turning downstream operations from

a push-based monologue into a curated, participatory dialogue that informs upstream production (Gamble et al., 2019).

3.2. Data-Driven Personalization and Sensory Logistics

The datafication of cultural consumption enables hyper-personalization of the downstream supply chain. AI and Big Data analytics move beyond basic recommendations to enable granular customer segmentation, predictive modeling of tastes, and context-aware delivery of content and products. Streaming services use algorithms not just for content curation but as core supply chain mechanisms that shape discovery, artist visibility, and consumption patterns (LaGroue, 2025). This data-driven approach enables sensory logistics, where the affective component of delivery is optimized. Music's role in shaping emotional response is well-established (Fong et al., 2025). In the Industry 4.0 context, this evolves into AI-generated adaptive soundscapes and personalized audio environments delivered via streaming platforms, deepening emotional resonance and brand immersion as part of the service offering (Clarencia et al., 2024).

3.3. Phygital Ecosystems, Omnichannel Flows, and New Transaction Models

For tangible creative goods, phygital integration represents a key innovation in SCM, merging physical and digital supply chains. IoT and QR codes connect physical products to digital layers of content, community, and commerce, enhancing product value, enabling new service offerings, and verifying authenticity to combat counterfeiting (Del Vecchio et al., 2023). This demands flawless omnichannel distribution, ensuring a seamless customer journey from social media discovery to in-store pickup or home delivery, requiring integrated inventory and customer data management (Lawry & Bhappu, 2021). Concurrently, business models themselves become supply chain design choices. Subscription and freemium models create predictable demand flows and build loyal communities, affecting inventory planning and cash flow (Panda, 2020). More disruptively, blockchain-enabled models like NFTs and smart contracts allow for decentralized creation, fan-driven value determination, and novel forms of patronage, directly merging downstream customer relationship management with upstream funding and production scheduling (Khan, 2024).

3.4. Community-Centric Strategy and Entrepreneurial Supply Chain Orchestration

Ultimately, smart SCM in creative industries is community-centric. The goal is to cultivate networked audiences and fan ecosystems that act not just as markets but as co-creators, promoters, and direct supporters within the value network (Qi, 2024). This requires creative firms, especially SMEs, to exhibit strong entrepreneurial orientation (EO)—innovation, proactiveness, risk-taking—coupled with a market orientation (MO) that is now executed through digital supply chain tools (Abduh et al., 2024). Success depends on leveraging platforms like Instagram for direct customer engagement and loyalty while integrating sophisticated AI and analytics tools for demand sensing and personalized logistics to remain competitive (Zong et al., 2025).

Consequently, at the nexus of Industry 4.0 and creative industries, a profound synthesis emerges where digital technologies are reconfigured as the primary operational infrastructure for cultural value creation and entrepreneurial scaling (Nasta, 2025; Lockwood et al., 2025). This integration is constitutive: cultural logic—the generation of symbolic meaning and affective experience—is encoded into supply chain operations through data-driven affective personalization and embedded within digitally networked co-creation ecosystems. Simultaneously, entrepreneurial action for creators and SMEs is executed through the agile orchestration of this digital infrastructure, utilizing dynamic, fan-driven value capture for financing and algorithmic community engagement for audience development (Abduh et al., 2024; Zong et al., 2025). Therefore, technology and operations management transcend a supportive role to become the fundamental platform through which cultural content is produced, distributed, and monetized in the digital era—a critical theoretical and practical gap that the present framework seeks to address.

Despite the rich and growing literature on digital transformation, co-creation, cultural economics, and individual Industry 4.0 technologies within creative sectors, a critical synthesis from a Supply Chain Management perspective is conspicuously lacking. Existing studies provide deep but fragmented insights—examining AI in music production, blockchain for art provenance, or XR in fashion retail in isolation (Malik et al., 2023; Clarencia et al., 2024). There is no integrated framework that cohesively explains what constitutes 'customer-centric supply chain processes' as a unified model specific to creative industries under the combined influence of AI, IoT, blockchain, and XR. The literature acknowledges the entrepreneurial shift, the importance of meaning-making, and the role of new technologies, yet fails to synthesize these strands into a structured conceptual model of the modern creative supply chain. This paper directly addresses this gap. Through a rigorous, systematic meta-synthesis of scholarly literature, it moves beyond fragmented analysis to integrate these disparate dimensions into a coherent SCM framework. Its objective is to construct a multi-dimensional model that delineates the core components—spanning customer-integrated value creation, omnichannel fulfillment, dynamic value capture, algorithmic engagement, and networked ecosystems—of a holistic, smart, and customer-centric supply chain process model uniquely configured for the creative industries in the Industry 4.0 era.

Materials and Methods

This study employs a qualitative approach, grounded in an interpretive paradigm, to examine customer-centric supply chain processes in creative industries. The research is descriptive-applied in nature and utilizes secondary qualitative data. The preliminary phase identified a gap in existing literature regarding comprehensive frameworks for Industry 4.0-enabled supply chain dimensions in creative sectors, leading to a systematic analysis of secondary sources to define the core dimensions of a customer-centric supply chain process model.

Employing a meta-synthesis approach, this research systematically examines the foundational dimensions of Industry 4.0-enabled, customer-centric supply chain processes within creative industries. A targeted search strategy was designed to identify relevant literature, resulting in the retrieval of scholarly articles published between 2016 and 2025 from leading academic databases. Following a rigorous screening process, 81 English-language publications were selected for in-depth analysis. Using meta-synthesis methods, these texts were analyzed to identify dimensions of downstream, customer-focused supply chain operations in creative sectors. The chosen timeframe (2016–2025) captures the period of accelerated maturation and tangible adoption of core Industry 4.0 technologies (e.g., AI, IoT, blockchain, XR) within creative industries. This period aligns with the mainstream scholarly discourse on their business applications, ensuring the synthesis includes both foundational insights and the latest innovative disruptions.

The meta-synthesis methodology is selected due to its specific suitability for the research objective. The goal is not to generate new primary data but to integrate fragmented findings from a diverse body of qualitative studies into a novel, coherent theoretical framework. Meta-synthesis is uniquely designed for such interpretive synthesis, as it enables the translation of isolated insights across contexts into a higher-order conceptual model that explains how Industry 4.0 technologies collectively reconfigure supply chain processes—an aim beyond the scope of a traditional literature review or primary case study analysis.

This methodology offers a systematic framework for synthesizing qualitative research, enabling the integration of diverse findings to uncover underlying themes and conceptual patterns related to Industry 4.0-enabled customer-centric supply chain processes. The approach significantly enhances the interpretive depth and comprehensiveness of results, providing a more holistic understanding of complex phenomena across interdisciplinary contexts (Mohammed et al., 2016). The seven-stage procedure of the meta-synthesis method is delineated in Figure 1.

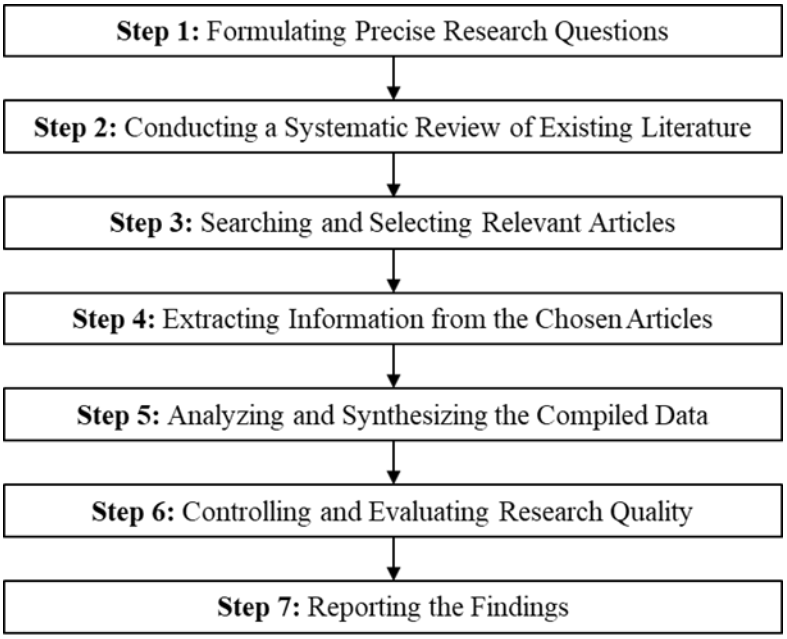

Figure 1. Seven steps of the meta-synthesis method (Sandelowski & Barroso, 2006)

Through the integration of diverse research findings, meta-synthesis produces a cohesive conceptual framework that yields novel insights and value beyond the scope of individual studies (Nye et al., 2016). This methodology systematically examines, critiques, and synthesizes existing literature with the primary objective of developing innovative models and frameworks (Sim & Mengshoel, 2023). As an evolving methodological approach, it consolidates multiple studies into a broader, practice-oriented conceptual understanding (Herber et al., 2019).

Results

Following the seven-phase meta-synthesis framework outlined in Figure 1, the research outcomes are presented accordingly. It is critical to note that the analysis and synthesis were conducted with a deliberate focus on interpreting the identified scholarly components through the lens of customer-centric supply chain management, thereby constructing them as integral processes within a downstream, digitally-enabled creative value chain.

First Step: Determining Research Questions in Meta-Synthesis

This initial phase involves establishing foundational research questions to delineate the study's scope and prevent ambiguities in later stages (Skinner et al., 2022). Each research effort must originate from a clearly defined question or objective, necessitating precise specifications (Berger et al., 2012). Meta-synthesis research questions concentrate on the essence of the study, the target population, and the temporal context (Mohammed et al., 2016). Accordingly, the principal research question directing this meta-synthesis was reframed to align with the study's core focus: "What are

the key components of Industry 4.0-enabled, customer-centric supply chain processes within creative industries, based on a systematic analysis of scholarly literature published between 2016 and 2025, and how can these dimensions be systematically classified into an integrative framework?"

To structure this inquiry, four key dimensions guided the process:

- "What?" – Focused on identifying, categorizing, and classifying the dimensions and elements of Industry 4.0-enabled, customer-centric supply chain processes within creative industries.
- "Who?" – Referred to the target population of literature, which included research focused on the intersection of digital technologies, customer engagement, and value delivery mechanisms within creative industries.
- "When?" – Specified the time frame, covering studies published between 2016 and 2025 to capture the evolution of Industry 4.0 technologies.
- "How?" – Defined the research methodology as a qualitative meta-synthesis of existing scholarly articles.

Second Step: Systematically reviewing research background.

In this phase, data were analyzed according to the strategic frameworks detailed in Table 1. The analysis integrated authoritative sources to guarantee a thorough and reliable examination of the field.

Table 1. Study Selection Criteria for Systematic Literature Review

Parameter	Inclusion Criteria
Study Time period	March 2025 to December 2025
Source Search Timeframe	From 2016 to 2025 AD (the last 10 years)
Research Language	English
Article Type	Papers published in reputable scientific journals
Study Method	Qualitative, meta-synthesis analysis
Geographical Scope	Not limited
Studied Topics	Industry 4.0, AI, IoT, Blockchain, XR/AR/VR, Personalization, Customer Relationship Management, Mass Customization, Digital Supply Chain, Creative Industries (e.g., fashion, music, design, film)
Statistical Population	Scientific data databases: Scopus and Web of Science
Studied Statistical Population	Creative industries (e.g., Music, Film, Fashion, Publishing)

Therefore, the criteria outlined in Table 1 for organizing the paper review—based on the keywords specified in Table 2—were searched using the "AND" operator simultaneously with the core terms "Creative Industries", "Industry 4.0" and "Customer-Centric Supply Chain".

Table 2. Search Keywords

Keywords
Industry 4.0
Creative Industries
Supply Chain Management
Digital Supply Chain
Customer-Centric
Mass Customization
Customer Relationship Management (CRM)
Personalization
Artificial Intelligence (AI)
Internet of Things (IoT)
Blockchain
Augmented Reality/Virtual Reality (AR/VR)

Third Step: Searching and Selecting Relevant Papers.

In this phase, articles were excluded according to title, predetermined inclusion/exclusion criteria, and abstract content. After candidate papers progressed to the final evaluation stage, critical appraisal techniques were employed to evaluate the caliber of the remaining studies (Shaheen et al., 2023). The initial search, utilizing combinations of the keywords in Tables 1 & 2, identified 218 articles from scientific journals. These sources underwent a systematic review considering content relevance, methodological rigor, and reported results. A summary of this filtering procedure is provided in Figure 2.

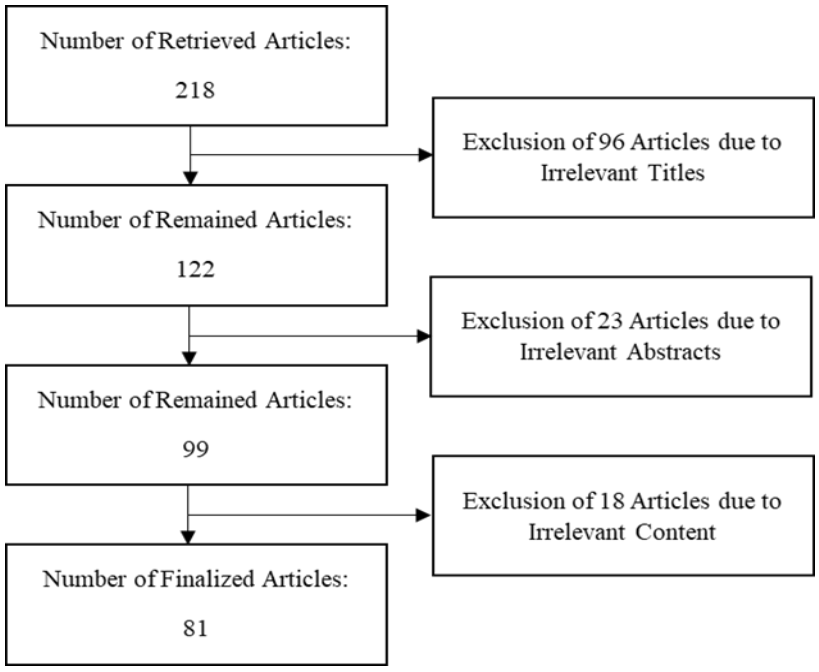

Figure 2. Summary of the Paper Selection Process

Subsequently, the Critical Appraisal Skills Program (CASP) checklist was employed to evaluate the quality of the included articles. This method appraises qualitative research against ten essential criteria. Each publication was assigned a score from 1 to 5 per criterion. Consistent with the thresholds in Table 3, only studies attaining a total score of 30 or higher were incorporated (Patel et al., 2022). The CASP evaluation criteria in this study include:

- Was there a clear statement of the aims of the research?
- Is a qualitative methodology appropriate?
- Was the research design appropriate to address the aims of the research?
- Was the recruitment strategy appropriate to the aims of the research?
- Were the data collected in a way that addressed the research issue?
- Has the relationship between researcher and participants been adequately considered?
- Have ethical issues been taken into consideration?
- Was the data analysis sufficiently rigorous?
- Is there a clear statement of findings?
- How valuable is the research? (Buccheri and Sharifi, 2017)

Table 3. Article Scoring (Scores Obtained)

Article Classification		Very Weak	Weak	Medium	Good	Very Good
Range of Classes	From	0	11	21	31	41
	To	10	20	30	40	50

In line with established practice for qualitative evidence synthesis using the CASP tool, all criteria were accorded equal weight to ensure reproducibility and avoid the introduction of subjective bias in the appraisal process. Following the scoring procedure, 59 publications met the quality threshold (score ≥30) and advanced to the final stage of analysis (Patel et al., 2022). The scores for these 59 articles are presented in Table 4 (detailed table of articles and scores would follow here in the full manuscript).

Table 4. Scores of 59 valid articles out of 81 reviewed articles using CASP

Authors (Year)	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8	Criterion 9	Criterion 10	Article Score
Asadi and Sultana (2025)	5	5	4	5	4	5	5	3	4	5	45
Bown (2025)	5	4	5	3	5	2	5	4	5	5	38
Gursesli et al. (2025)	4	4	5	5	3	3	5	4	4	4	41
Jenkins (2025)	4	4	5	5	5	4	3	5	3	5	43
Oppenlaender et al. (2025)	4	4	3	5	5	4	5	4	3	4	41
Pilati et al. (2025)	5	3	4	5	5	4	4	3	2	3	38
Pires (2025)	5	4	4	4	5	4	4	4	5	4	43
Zhang et al. (2025)	5	4	5	4	5	5	4	4	4	3	43
Chen et al. (2024)	4	5	3	5	5	5	4	3	4	5	43
Davies et al. (2024)	4	4	5	5	3	3	4	5	5	5	43
Liao et al. (2024)	2	4	5	4	2	5	4	4	5	3	38
Ma et al. (2024)	4	4	3	4	4	5	5	5	4	4	42
Massari et al. (2024)	5	5	4	3	4	4	3	4	5	5	42
Huggard and Särmäkari (2023)	5	3	5	4	4	5	5	5	4	3	43
Mai and Hu (2023)	5	3	4	4	4	3	4	2	4	5	38
Onderdijk (2023)	3	3	3	5	4	5	5	4	5	5	42
Singh et al. (2023)	5	3	5	5	3	4	4	5	4	4	42
Villagran-Vizcarra et al. (2023)	5	4	4	3	4	4	5	5	5	5	44
Voštinár and Ferianc (2023)	4	3	4	3	4	5	5	4	5	4	41
Wang and Majeed (2023)	3	5	3	5	3	4	5	4	4	3	39
Yıldız et al. (2023)	5	4	3	2	4	4	5	5	4	4	40
Bavi and Gupta (2022)	2	4	3	3	5	4	4	3	4	5	37
Gonzalez (2022)	4	5	4	4	5	3	5	4	4	5	43
Haaften-Schick and Whitaker (2022)	3	5	5	4	3	4	5	4	5	4	42
Haruvi et al. (2022)	5	5	4	4	5	4	5	5	5	4	46
Huang et al. (2022)	3	4	3	5	3	5	5	3	5	4	40
Mahar (2022)	4	5	5	4	4	3	3	5	5	4	42
Rospigliosi (2022)	3	5	5	5	4	5	4	3	5	5	44
Drott (2021)	4	4	5	4	3	5	4	2	5	5	41
Hennig-Thurau et al. (2021)	5	4	4	5	4	3	5	4	3	4	41
Zeagler (2021)	4	4	4	4	5	3	5	5	5	5	44
Zidianakis et al. (2021)	3	5	5	5	4	5	3	4	3	5	42
Acquila-Natale and Chaparro-Peláez (2020)	3	4	4	3	5	5	4	5	5	4	42
Have and Pedersen (2020)	5	4	3	4	5	4	4	5	4	4	42
Lim, F and Toh (2020)	5	5	4	5	5	5	5	5	5	4	48
Morris (2020)	5	4	5	4	5	4	4	5	5	5	46
Mukendi and Henninger (2020)	3	2	4	4	3	4	4	4	3	3	34
Werner (2020)	5	5	4	5	3	4	4	5	5	5	45
Clarke-Midura et al. (2019)	3	4	3	5	5	4	5	4	4	4	41

Authors (Year)	Criterion 1	Criterion 2	Criterion 3	Criterion 4	Criterion 5	Criterion 6	Criterion 7	Criterion 8	Criterion 9	Criterion 10	Article Score
Duffy et al. (2019)	3	4	3	3	3	4	4	3	5	4	36
Lolli (2019)	5	4	4	5	5	4	3	5	4	5	39
Smits and Nikdel (2019)	4	3	5	3	4	5	5	4	5	3	41
Yuan and Shen (2019)	4	3	3	3	5	4	3	4	4	4	37
Colombi et al. (2018)	5	5	4	4	4	3	5	4	3	4	41
He et al. (2018)	3	3	4	4	5	4	5	5	5	5	43
Liapis et al. (2018)	3	3	4	4	4	3	5	5	5	5	41
Navar-Gill et al. (2018)	4	4	4	5	4	4	5	4	4	5	43
Park et al. (2018)	5	5	5	5	5	4	4	5	5	4	47
Prey (2018)	4	5	3	3	4	3	5	5	4	5	41
Scholz and Duffy (2018)	5	4	2	4	5	4	3	4	3	4	38
Turchet (2018)	5	4	4	2	3	4	3	3	4	5	37
Aluri (2017)	4	5	5	4	3	5	4	3	5	3	41
Benghozi et al. (2017)	4	4	5	3	2	5	4	4	5	4	40
Ellis and Ellis (2017)	5	5	4	5	5	4	5	5	4	5	47
Hjorth and Richardson (2017)	4	4	4	4	5	5	4	5	4	5	44
Wang and Li (2017)	4	5	5	4	5	3	3	3	4	5	41
Hobbs (2016)	5	5	5	3	3	4	3	4	5	5	42
Karaman et al. (2016)	4	4	4	5	4	5	5	4	5	4	44
Lawless and Medvedev (2016)	5	5	5	4	5	4	4	5	5	5	47

Table 4 delineates the appraisal scores for 81 initially selected articles, as evaluated by the Critical Appraisal Skills Program (CASP) criteria. From a total of 81 articles assessed, 22 publications scoring below 30 were eliminated from further consideration. The final cohort of 59 articles, satisfying the validity threshold, was consequently approved for subsequent data analysis.

Fourth Step: Extracting Information from Selected Articles

The findings from the finalized articles were extracted via an iterative review process. A standardized monitoring protocol was employed to ensure the systematic capture of relevant insights. This instrument recorded essential metadata, including author names, publication year, journal title, and principal findings (Cahill et al., 2018). The ultimate article selection was subjected to a rigorous examination process. Code extraction criteria were aligned with the research questions established at the study's outset. Systematic coding of the articles was conducted using the monitoring checklist, which encompassed dimensions such as article identifier, publication year, authors, and core findings pertinent to “Industry 4.0-enabled, customer-centric supply chain processes in creative industries”, as derived explicitly from the texts.

During the fourth phase, 54 open codes derived from secondary data were identified. These codes alongside their respective sources are comprehensively documented in columns (3) and (4)

of Table 5. It should be noted that the outcomes from both the fourth and fifth phases have been consolidated and are presented jointly within Table 5.

Table 5. Axial Coding Framework

Axial code	Commonality of Open Codes	Open code	Source
Customer-Integrated Value Creation	AI-facilitated user agency in content and product generation, enabling co-design and mass customization as an upstream input into the supply chain.	Empowering customers to personalize aesthetic and textual elements	Zhang et al. (2025)
		Utilizing sophisticated algorithms to deliver personalized song recommendations	Werner (2020)
		User-led design and construction of custom virtual worlds within interactive gaming ecosystems	Rospigliosi (2022)
		User-driven alteration of artistic creations through feature, style, and form adjustments	Oppenlaender et al. (2025)
Responsive & Adaptive Fulfillment Environments	Context-aware and real-time adaptive systems that respond to user inputs or environmental data to customize the delivery of experiences, content, or physical goods.	Providing interactive artistic installations in museums that dynamically respond to viewer gestures or choices	Karaman et al. (2016)
		Generating storylines dynamically from Gamer input	Gursesli et al. (2025)
		Adaptive ambient music generation responsive to temporal patterns and user activity	Bown (2025), Drott (2021)
		Enabling control of devices via touch-sensitive clothing	Zeagler (2021)
Immersive Experience Delivery (XR)	The use of extended reality technologies to deliver and enhance product trials, events, and narratives, creating a seamless layer between digital content and physical consumption.	Customers trying make-up virtually before buying	Scholz and Duffy (2018)
		Immersion of users within interactive three-dimensional environments during virtual concerts	Onderdijk (2023)
		Integration of digital gameplay into physical environments, generating a deeply interactive hybrid experience	Hjorth and Richardson (2017), Aluri (2017)
Affective & Biometric Personalization	Leveraging real-time emotional and physiological data to dynamically adapt and personalize content, difficulty, or ambiance, tailoring the experiential aspect of delivery.	Harmonizing music in real-time with the listener's biometrics and emotions for a deeply personalized auditory experience	Haruvi et al. (2022)
		Automated adaptation of challenges based on players' anxiety levels or heart rate	Davies et al. (2024)
Sustainable & Digital Resource Management	Integrating sustainable physical materials and developing immersive digital assets, reflecting responsible sourcing and innovative resource use within the production cycle.	Employment of recycled materials and sustainable design practices in the fashion industry	Ma et al. (2024), Lawless and Medvedev (2016)
		Development of immersive educational experiences through augmented reality-enabled interactive books	Singh et al. (2023)

Axial code	Commonality of Open Codes	Open code	Source
Phygital System Integration	The seamless operational integration of tangible products with digital interfaces and data, creating interactive, adaptive systems for product use, education, or performance.	Toys combining physical building blocks with digital apps to create a highly interactive play experience	Clarke-Midura et al. (2019)
		Merging physical learning aids with digital content to enhance interactivity	Voštinár and Ferianc (2023)
		Physical-digital components to produce customized auditory outputs in real-time through musical instruments	Turchet (2018)
Omnichannel Distribution Networks	Interconnected integration of multiple access points and channels to ensure a unified, fluid, and continuous flow of goods, services, and experiences to the consumer.	Seamless integration of physical and digital channels, enabling unified consumer access and purchasing across all platforms	Acquila-Natale and Chaparro-Peláez (2020)
		Multi-device content accessibility enabling seamless user access across smartphones, laptops, and smart TVs globally	Gonzalez (2022)
		Integration of print and digital access, enabling readers to transition fluidly between formats	Lim, F and Toh (2020)
Immersive Commerce Platforms	The fusion of immersive technologies and phygital interfaces to transform transactional points into interactive, experiential purchasing and engagement environments.	Leveraging AR/VR to generate immersive, interactive experiences that drive art and merchandise commercialization	Massari et al. (2024), He et al. (2018)
		Smart mirrors and virtual try-on apps, merging physical and digital realms to elevate retail experiences	Chen et al. (2024)
Decentralized Digital Marketplaces	Blockchain-enabled platforms that disintermediate traditional distribution, enabling direct global access, creator-centric monetization, and peer-to-peer digital asset exchange.	Global digital art distribution bypassing traditional galleries via blockchain-based marketplaces	Jenkins (2025)
		Enabling artists to monetize and distribute NFTs directly to collectors	Haaften-Schick and Whitaker (2022)
		Global digital distribution of independent cinema	Smits and Nikdel (2019)
AI-Optimized Dynamic Logistics & Pricing	AI-driven, real-time adjustments in pricing, availability, and content delivery mechanisms in response to demand variability, competition, and individual user context.	Real-time AI-driven ticket pricing, adjusting dynamically with demand fluctuations	Pires (2025)
		Premium pricing for high-demand theater elements contrasted with off-peak affordability	Ellis and Ellis (2017)
		Context-aware content delivery in music, such as personalized virtual concerts and algorithmic playlists	Morris (2020)
		Offering same-day delivery options in urban centers	Mahar (2022)
Subscription & Access-Based Models	Recurring revenue structures that replace ownership with flexible,	Offering unlimited content access via flat-rate subscriptions, displacing transactional pay-per-view models	Hennig-Thurau et al. (2021)

Axial code	Commonality of Open Codes	Open code	Source
	service-based access to content, products, or experiences, creating predictable demand cycles.	Luxury clothing rentals through monthly subscriptions	Mukendi and Henninger (2020), Yuan and Shen (2019)
Fan-Driven Value Capture & Financing	Financial models that enable direct consumer-to-creator support, decentralized funding, and consumer-determined value allocation, integrating the audience into the funding supply chain.	Empowering fans to set personalized payment amounts for albums, strengthening artist loyalty and direct patronage	Pilati et al. (2025)
		Crowdfunding film projects that premiere globally, circumventing traditional studio systems	Hobbs (2016)
		Crowdfunded projects evolving into major commercial successes	Lolli (2019)
Freemium & Microtransaction Models	Strategies offering foundational access without cost while monetizing through optional enhancements, premium features, or exclusive digital content, managing tiered value delivery.	Freemium mobile games: free base access with paid upgrades or exclusives	Mai and Hu (2023)
		Creative software with free core access and paid advanced features	Wang and Li (2017)
Algorithmic Community Engagement	Algorithmically amplified user-generated content and interactions that foster organic community co-creation, driving engagement and leveraging participatory culture for ecosystem growth.	Engaging influencers and users as co-creators of brand narratives through user-generated content, fostering a sense of collective ownership	Asadi and Sultana (2025)
		Songs achieve viral popularity through user-generated short videos on social media platforms, serving as organic promotional instruments	Park et al. (2018)
Gamified Experience & Loyalty Systems	The strategic use of game-inspired interactive mechanics to transform passive consumers into active participants, enhancing engagement, loyalty, and anticipation through structured experiences.	Deploying pre-release interactive narrative puzzles in film marketing to incrementally disclose content and heighten audience anticipation	Benghozi et al. (2017)
		Employing time-limited branded events to enhance gameplay engagement and brand visibility	Liao et al. (2024)
		Artists gamifying engagement through task-rewarded interactive experiences	Bavi and Gupta (2022)
Behavioral Data-Driven Personalization	Utilizing behavioral data across platforms to enable hyper-personalized interactions, recommendations, and communications, optimizing customer touchpoints in the delivery chain.	Advertisements tailored to individual listening behaviors on music streaming platforms	Prey (2018)
		Generating hyper-personalized advertisements and product recommendations in fashion retail through analysis of customer browsing history and purchase behavior	Yıldız et al. (2023)
		Curated audiobook and e-book recommendations tailored to individual reading history	Have and Pedersen (2020)

Axial code	Commonality of Open Codes	Open code	Source
AI-Facilitated Collaborative Production	Platforms and tools that enable user-driven content generation and integration of collaborative inputs into production ecosystems, facilitating co-creation at scale.	Co-design initiatives integrating user-submitted designs into production pipelines	Zidianakis et al. (2021)
		Facilitating collaborative music creation through user-generated content integration on digital platforms	Wang and Majeed (2023)
		Enabling players to generate and share new content or levels within the game world	Liapis et al. (2018)
Networked Audience Ecosystems	Digitally-mediated communities that enable direct support, participatory engagement, and loyalty cultivation, functioning as vital networks for feedback, advocacy, and value co-creation.	Establishing fan communities that enable direct financial patronage to artists	Navar-Gill et al. (2018)
		Fostering brand loyalty through enhanced gameplay in community structures	Huang et al. (2022)
		Integration of physical products with digital interfaces to create immersive dual-layer experiences	Villagran-Vizcarra et al. (2023)
		Creating immersive pop-up stores with interactive elements like AR try-ons to transform shopping into a memorable experience	Colombi et al. (2018)
Decentralized Creator Platforms	Direct creator-to-consumer monetization platforms that disintermediate traditional channels, enabling user-enabled value creation and on-demand, personalized production.	Facilitating direct publication and monetization of creative works via digital platforms	Duffy et al. (2019)
		Empowering customers as co-creators through made-to-order platforms that enable personalized design of apparel and accessories, minimizing waste via on-demand production	Huggard and Särmäkari (2023)

Fifth Step: Data Analysis and Synthesis

The primary aim of meta-synthesis is to develop an integrated, comprehensive, and novel interpretation of the research findings, an outcome realized in this phase. During the fifth step of the meta-synthesis process, the researcher systematically categorizes, codes, and synthesizes outcomes from the selected articles to formulate the most precise and exhaustive understanding of the central research subject (Hoon, 2013). At this stage, open codes exhibiting semantic similarities are consolidated. The resulting secondary codes, which demonstrate conceptual and pragmatic affinities, are subsequently grouped. This procedure culminates in the derivation of axial codes, or themes, which encapsulate the shared attributes of the secondary codes. These emergent themes and commonalities are presented in Table 5.

Sixth Step: Monitoring and Evaluating Research Quality

Within the meta-synthesis methodology, external validity is deemed irrelevant as the synthesized outcomes are not designed to be generalized across a wider population. Consequently, the focus rests exclusively on internal validity, which entails a rigorous examination of the research

objectives and structural framework to affirm the precision and trustworthiness of the conclusions (Habersang & Reihlen, 2025). The Critical Appraisal Skills Program (CASP) tool was utilized to perform a qualitative assessment of the study content. Furthermore, the inter-coder agreement technique was applied to fortify the reliability of the analytical model.

Reliability was assessed utilizing the Kappa coefficient. For this purpose, 59 coded articles were randomly selected for review by an expert in creative industries supply chain management. Two researchers identified a total of 47 codes from the findings of the studies. The inter-coder agreement, measured by the Kappa coefficient, was calculated at 79.38%, denoting an acceptable level of consistency. This result confirms that the quality of the extracted concepts is satisfactory. The procedures implemented in this phase were designed to guarantee the quality and precision of the research process, accurately pinpoint study-relevant concepts, and facilitate ongoing review and refinement to maintain the integrity of the results.

Seventh Step: Reporting the Findings

The outcomes from the preceding phases were systematically integrated and structured into a cohesive model. This framework is presented in Table 6 and illustrated graphically in Figure 3. To establish validity, the findings underwent evaluation and endorsement by three domain experts via a survey, who verified the model's overarching structure and its constituent elements.

Table 6. Classification Results

Main Category (Component)	Revised Axial Code	Number of Open Codes (Subcategories)
Customer-Integrated Value Creation	Customer-Integrated Value Creation	4
	Responsive & Adaptive Fulfillment Environments	4
	Immersive Experience Delivery (XR)	3
	Affective & Biometric Personalization	2
	Sustainable & Digital Resource Management	2
	Phygital System Integration	3
Omnichannel & Immersive Fulfillment	Omnichannel Distribution Networks	3
	Immersive Commerce Platforms	2
	Decentralized Digital Marketplaces	3
	AI-Optimized Dynamic Logistics & Pricing	4
Dynamic Value Capture & Access Models	Subscription & Access-Based Models	2
	Fan-Driven Value Capture & Financing	3
	Freemium & Microtransaction Models	2
Algorithmic & Gamified Community Engagement	Algorithmic Community Engagement	2
	Gamified Experience & Loyalty Systems	3
	Behavioral Data-Driven Personalization	3
Networked Co-Creation Ecosystems	AI-Facilitated Collaborative Production	3
	Networked Audience Ecosystems	4
	Decentralized Creator Platforms	2

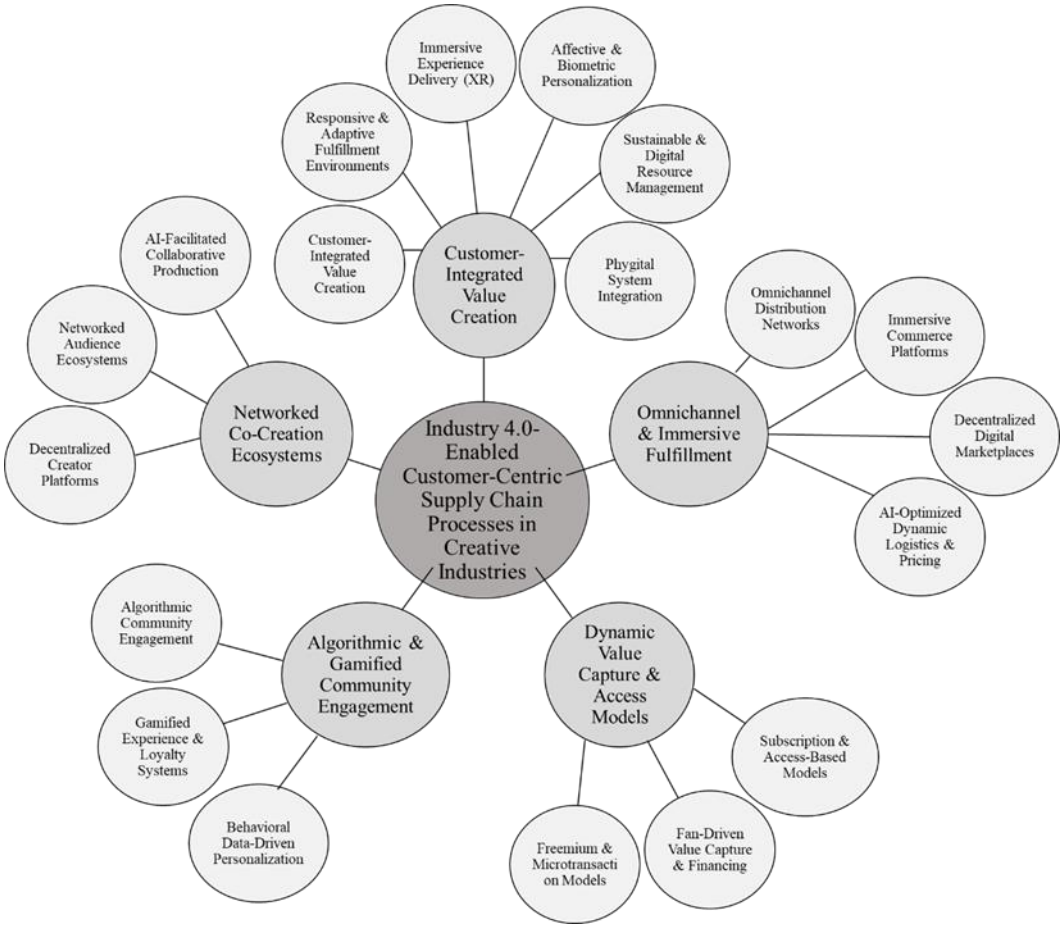

Figure 3. Components and Categories of Industry 4.0-Enabled, Customer-Centric Supply Chain Processes in Creative Industries

Based on Figure 3, this visual model synthesizes the five core components derived from the meta-synthesis, depicting the Networked Co-Creation Ecosystems as the foundational, enabling layer. The arrows illustrate the primary dynamic interdependencies and value flows that define the system's operation: (1) Value propositions co-created within Customer-Integrated Value Creation are delivered through Omnichannel & Immersive Fulfillment channels. (2) The community activated via Algorithmic & Gamified Community Engagement directly fuels both value creation and Dynamic Value Capture & Access Models. (3) Revenue captured through these dynamic models feeds back to sustain and incentivize the entire ecosystem. This representation emphasizes that the framework functions as an integrated, feedback-driven network rather than a linear chain, with technological synergies (AI, IoT, Blockchain, XR) enabling these flows across all components. This final integrative framework (Figure 3) is the direct conceptual synthesis of the axial codes derived from the meta-synthesis (Table 5), where each of the five main components is constituted by grouping several thematically related axial codes (e.g., Customer-Integrated Value

Creation comprises codes such as Affective & Biometric Personalization and Phygital System Integration). Thus, the arrows depicting dynamic relationships and value flows between these aggregated components illustrate how the specific operational processes, identified and coded from the literature, interact within a holistic, customer-centric creative supply chain ecosystem.

Discussion

This study set out to address a critical fragmentation in the academic discourse surrounding Industry 4.0 and customer-centric operations within the creative industries. While the literature review confirmed a wealth of knowledge on discrete technologies and their applications in specific sub-sectors, it revealed a pronounced lack of a synthesized, holistic model from a supply chain management perspective. The systematic meta-synthesis conducted here has allowed us to move beyond this fragmentation. The resulting framework—comprising the five integrated components of Customer-Integrated Value Creation, Omnichannel & Immersive Fulfillment, Dynamic Value Capture & Access Models, Algorithmic & Gamified Community Engagement, and Networked Co-Creation Ecosystems—provides a coherent architecture for understanding customer-centric supply chain processes as a unified, systemic phenomenon in the creative economy. This discussion interprets the significance of these findings, synthesizes them with prior research, and elucidates the novel understanding they provide.

Prior to discussing the framework's components, it is essential to define key operational terms underpinning this synthesis. Phygital systems are integrated architectures where physical products or environments are seamlessly connected to and enhanced by digital layers (e.g., data, interfaces), creating a unified customer experience. Affective personalization refers to using data analytics and AI to tailor products or interactions based on a user's emotional state or biometric feedback, going beyond demographic segmentation. Fan-driven financing is a decentralized model where audiences directly fund projects (e.g., via crowdfunding or NFTs), often in exchange for exclusive access or co-creative influence, bypassing traditional intermediaries.

The proposed framework illustrates how synergistic technology interactions—rather than mere additive lists—constitutively form the operational backbone of each component, enabling the dynamic, customer-centric flows that redefine the creative supply chain. To elucidate these critical interconnections, we analyze key dyadic technology interactions underpinning the framework’s functionality with concrete industry examples:

The framework's functionality stems from specific dyadic synergies between Industry 4.0 technologies. The AI-XR synergy underpins Customer-Integrated Value Creation: AI generates personalized options that XR renders into immersive co-design environments, as seen in digital fashion platforms like Browzwear. The IoT-Blockchain synergy supports Omnichannel &

Immersive Fulfillment by creating trusted physical-digital flows; IoT sensors track product data immutably logged on blockchain for provenance, exemplified by LVMH's AURA platform. The AI-Blockchain synergy enables Algorithmic & Gamified Community Engagement, where AI curates content and blockchain smart contracts automate transparent reward distribution, as in community-driven NFT projects like Bored Ape Yacht Club.

Collectively, these dyadic interactions serve as the integrative connective tissue of the framework. The AI-XR synergy feeds personalized value into the ecosystem; the IoT-Blockchain synergy secures physical-digital fulfillment; and the AI-Blockchain synergy orchestrates and incentivizes community engagement. This web of synergies ensures the framework operates as a self-reinforcing, customer-centric network where data, assets, and experiences flow seamlessly through the constitutive integration of Industry 4.0 technologies.

The derived model confirms that digital transformation in creative supply chains is not merely the digitization of traditional logistics but a fundamental reconstitution of operational logic itself, centered on dynamic value co-creation and ecosystem orchestration. This aligns with the broader shift from linear, transaction-focused models to adaptive, relational value networks highlighted by scholars like Dash et al. (2021), and Aheleroff et al. (2021). However, our synthesis specifies how this shift manifests uniquely in creative contexts where emotional resonance and symbolic meaning are paramount deliverables of the operational process.

First, the Customer-Integrated Value Creation component expands the traditional "product" into a fluid, interactive, and often phygital value proposition. The identification of elements like Customer-Integrated Value Creation and Affective & Biometric Personalization directly connects the technological capabilities discussed by Clarencia et al. (2024) to the core creative imperative of emotional resonance and user agency emphasized by Kay and Polonsky (2010). While literature has discussed AI in generative art or adaptive music in isolation, our framework positions these as integral mechanisms for upstream value definition and design within the supply chain. Similarly, the inclusion of Sustainable & Digital Resource Management integrates the growing ethical and environmental consciousness into the core sourcing and production paradigm, a dimension often sidelined in purely tech-centric analyses.

Second, the Omnichannel & Immersive Fulfillment component crystallizes the dissolution of channel boundaries into a cohesive distribution and delivery strategy. It synthesizes previously disconnected strands of literature on omnichannel retail, phygital integration, and decentralized marketplaces. The framework demonstrates that distribution, as explored by Lawry and Bhappu (2021), is no longer a mere logistics function but the primary experiential interface with the customer. The co-presence of omnichannel strategies with the decentralized digital marketplaces analyzed by Malik et al. (2023) captures the current dual reality in downstream logistics: a

simultaneous evolution towards seamless integration and disruptive disintermediation, offering creators a strategic spectrum of fulfillment pathways.

Our findings critically extend the concept of value delivery and monetization under Industry 4.0. The Dynamic Value Capture & Access Models component reveals a move beyond simple dynamic pricing to include value models intrinsic to digital culture and community. Fan-Driven Value Capture & Financing and Freemium Models are not just pricing tactics but profound mechanisms for integrating the customer into the financial and support structure of the creative enterprise, directly enabling the entrepreneurial artist model described by Win (2014), and Abduh et al. (2024). This synthesizes revenue strategy with community-based resource allocation, an integration less explicitly developed in prior operations management literature.

In Algorithmic & Gamified Community Engagement, the synthesis confirms the transition from one-way communication to recursive, system-driven interaction. The axial code Algorithmic Community Engagement formalizes the insight from Pizzolitto (2024), and Gamble et al. (2019) that platforms and algorithms are not just media but the very operational infrastructure for sustaining participation and co-created meaning. Furthermore, Gamified Experience & Loyalty Systems codifies how operational engagement borrows from the logic of gaming and interactive storytelling—core to creative sectors themselves—to transform customer interaction into a structured, participatory loyalty-building process, thus blurring the line between service delivery and the creative product.

Operationally, this component translates into measurable practices and KPIs. Implementation examples include A/B testing algorithmically-curated feeds, deploying interactive time-limited challenges with clear metrics, and using smart contracts to automatically reward user-generated content. Measurable indicators for managers and researchers could include: algorithmically-driven engagement rate, gamification completion rate, growth in user-generated content volume, token distribution fairness scores, and community sentiment analysis tied to specific interventions.

The most significant integrative insight from this meta-synthesis is the positioning of Networked Co-Creation Ecosystems not as a peripheral support function, but as the foundational bedrock and ultimate output of the entire model. This directly addresses the literature on the "market for meaning" explored by Chang et al. (2021), and the entrepreneurial creator discussed by Lockwood et al. (2025), providing a structural link between these concepts and Industry 4.0 tools within a supply chain context. The framework shows that AI-Facilitated Collaborative Production, Networked Audience Ecosystems, and Decentralized Creator Platforms are interconnected systems that enable the network to function as a co-creative, self-sustaining production and distribution ecosystem. This elevates the community from a passive audience to the central organizing principle and value-generating engine of the creative supply chain, a nuanced understanding that generic operational models lack.

While this integrative framework offers a foundational model, its application requires sector-specific adaptation. The emphasis of its five components varies: in music, Algorithmic & Gamified Community Engagement and Fan-Driven Financing may dominate; in gaming, Customer-Integrated Value Creation and Networked Co-Creation Ecosystems are often core, supported by Dynamic Value Capture; while fashion may prioritize the Phygital aspects of Omnichannel Fulfillment and Affective Personalization. Thus, the framework is a flexible heuristic—its generalizability lies in its comprehensive structure, but practical utility depends on adapting to each sub-sector's unique value logic, technology, and community dynamics.

Theoretically, this study provides the missing horizontal synthesis from a Supply Chain Management perspective, offering a unified model that explains how technological, cultural, entrepreneurial, and experiential dimensions interact within customer-integrated value flows. It advances understanding from isolated insights to viewing the supply chain as a holistic, adaptive system. The framework serves as a foundational theory for testing component relationships empirically. Practically, it acts as a strategic operational roadmap for creators and SMEs, transforming fragmented digital tools into a structured ecosystem for value delivery. Future research should empirically validate the framework's relationships and explore ethical tensions between algorithmic personalization and artistic integrity, or data-driven efficiency and creative risk.

Conclusion

This study undertook a systematic meta-synthesis to address a critical, identified gap in the literature: the lack of a holistic, unified model explaining how Industry 4.0 technologies collectively reconfigure downstream supply chain processes into an integrated, customer-centric system within the creative industries. While extensive research exists on discrete technologies or sub-sectors, our analysis of 59 scholarly works reveals that the academic landscape has been fragmented, offering pieces but not the complete picture. The resultant framework—comprising Customer-Integrated Value Creation, Omnichannel & Immersive Fulfillment, Dynamic Value Capture & Access Models, Algorithmic & Gamified Community Engagement, and Networked Co-Creation Ecosystems—provides this necessary synthesis. It moves the discourse from isolated observations to an understanding of the creative supply chain as a dynamic, interdependent ecosystem where technology orchestrates cultural meaning and community-integrated value delivery. This conclusion consolidates the larger significance of this research by outlining its theoretical and managerial contributions and by charting a path for future inquiry.

Theoretical Implications

This research makes several pivotal theoretical contributions. Primarily, it addresses the fundamental gap by proposing the first integrated model that explicitly synthesizes the disparate technological, cultural, and entrepreneurial dimensions of Industry 4.0-enabled, customer-centric supply chain processes for the creative sectors. It advances theory by showing that digital transformation in this context is not merely the digital augmentation of traditional logistics, but a paradigmatic shift to a value-co-creation ecosystem. The model demonstrates how customer-integrated design, omnichannel fulfillment, dynamic value capture, algorithmic engagement, and networked production are functionally interconnected and fundamentally driven by the goal of cultivating Networked Co-Creation Ecosystems.

Furthermore, it introduces a new way of thinking about the research problem by positioning the community and its digital networks not as a market or channel, but as the core operational infrastructure and value-generating engine. This bridges and expands upon previously siloed theoretical strands—such as the "market for meaning," entrepreneurial artistry, and co-creation theory—by placing them within the architectural context of cyber-physical supply chain integration. Consequently, this framework provides a unified theoretical lens through which future studies can analyze the creative digital economy, offering a structured basis for hypothesizing and testing the relationships between technological capabilities, experiential depth, and sustainable cultural entrepreneurship.

Managerial or Policy Implications

The framework provides concrete strategic guidance by refocusing strategy through an operational lens, offering a roadmap that transcends isolated tools. It advises practitioners to: first, strategically integrate components (e.g., linking AI co-design with decentralized platforms) to create synergies; second, prioritize ecosystem orchestration by investing in networked co-creation ecosystems to activate communities; and third, adopt agile value capture models—from subscriptions to fan-driven financing—to build revenue resilience and deepen audience relationships.

Limitations of the Study

Despite its contributions, this study has limitations that pave the way for future research. First, as a conceptual framework derived from a qualitative meta-synthesis, it requires empirical validation. The proposed interrelationships among the five components and their collective impact on operational or financial performance metrics (e.g., time-to-market, customer lifetime value, resilience) need to be tested quantitatively in specific creative sectors. Second, the methodological scope is inherently shaped by the available literature, which predominantly comprises qualitative case studies. Future work could employ mixed-methods or longitudinal designs to quantify effects and capture the dynamic evolution of these ecosystems. Third, the framework focuses on

technological enablers and operational logic, leaving critical contextual and ethical dimensions—such as the digital divide, data privacy, algorithmic bias, and varying intellectual property regimes across regions—as vital avenues for further exploration.

Ideas for Future Research

The integrative framework presented herein opens several critical pathways for future scholarly inquiry grounded in operations and supply chain theory. First and foremost, the proposed interdependencies between the five components require robust empirical validation. Future studies should develop measurable scales for these constructs and test their causal relationships within specific creative sub-sectors to transition the model from a conceptual map to a validated theory. Second, the operationalization of this digital ecosystem surfaces pressing ethical and risk-related questions that demand focused investigation. Scholars should examine the tensions between algorithmic efficiency and artistic autonomy, the implications of affective computing for well-being, the governance of decentralized production, and the "dark side" risks such as community manipulation, creator burnout, and digital exclusion. Third, the dynamic and contextual nature of the framework calls for longitudinal and comparative research. Longitudinal studies are needed to track the evolution of power dynamics and value flows within these ecosystems over time, while comparative analyses could explore how the model's configuration varies across different cultural contexts and creative industries (e.g., gaming versus performing arts). Finally, to bridge theory with practice directly, a promising avenue is the development of a diagnostic maturity model based on this framework. Such a tool would enable creative enterprises to assess their current capabilities across the five components, identify strategic gaps, and prioritize technology investments, thereby transforming the theoretical synthesis into an instrument for managerial benchmarking and operational advancement.

In sum, this study has provided a crucial synthesis, transforming fragmentation into a coherent framework that clarifies the architecture of contemporary, technology-enabled value delivery in the creative economy. It demonstrates that in the Industry 4.0 era, sustainable success is rooted in the ability to orchestrate a responsive, integrated, and community-powered supply chain system for co-creating and delivering meaning and value. This conceptual advancement not only fills a significant literature gap at the intersection of supply chain management and creative industries but also provides a robust foundation for both strategic practice and the next generation of research in this dynamic field.

Data Availability Statement

Data available on request from the authors.

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Ethical considerations

The authors avoided data fabrication, falsification, and plagiarism, and any form of misconduct.

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Conflict of interest

The authors declare no conflict of interest.

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