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DIGITAL TRANSFORMATION IN THE GLOBAL SUPPLY CHAIN: LINKING THE GIG ECONOMY, MARITIME LOGISTICS, AND FMCG RETAIL

Abstract. *In today's global economy, digital transformation is fundamentally reshaping supply chains by integrating advanced technologies across three critical domains: the gig economy, maritime logistics, and FMCG retail. Supply chain management has shifted from traditional linear processes toward interconnected, data-driven ecosystems that enhance transparency, efficiency, and customer responsiveness. This paper explores the interdependence and convergence of these domains, with a particular focus on emerging economies such as Georgia, where digital transformation is increasingly prioritized.*

The gig economy is redefining labor in logistics, particularly in last-mile delivery, warehousing, and on-demand retail services, with platforms like Wolt and Glovo shaping consumer behavior and creating flexible labor markets. Maritime logistics, which carries over 80% of global trade, is being revolutionized by port community systems, and real-time data platforms that support cross-border trade facilitation. Simultaneously, FMCG retail is rapidly adopting omnichannel models, electronic data interchange (EDI), AI-driven forecasting, and inventory automation to meet rising consumer expectations. In Georgia, these changes are visible, the expansion of branded retail chains, and the surge of e-commerce.

By synthesizing academic literature, international reports, and Georgian sectorial data, this study highlights both opportunities and challenges of supply chain digitalization. The paper contributes a conceptual framework for better understanding cross-sector coordination in digital supply chains.

This paper explores the interdependence and interconnectedness of these sectors amid technological transformation, highlighting how new business models are formed, efficiency is improved, and customer experience is enhanced. Particular focus is placed on coordination, real-time data utilization, and strategies based on digital innovations.

Key words: *Digital transformation, supply chain, gig economy, maritime logistics, FMCG retail.*

JEL classification: *O33, R41, L81.*

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ციფრული ტრანსფორმაცია გლობალურ მიწოდების ჯაჭვში: გიგ ეკონომიკის, საზღვაო ლოჯისტიკისა და FMCG რითეილის თანაჯაჭვადობა

აბსტრაქტი: თანამედროვე გლობალურ ეკონომიკაში ციფრული ტრანსფორმაცია მნიშვნელოვნად გარდაქმნის მიწოდების ჯაჭვს, ინტეგრირებული თანამედროვე ტექნოლოგიების საშუალებით, სამი სექტორის მიმართულებით: გიგ ეკონომიკაში, საზღვაო ლოჯისტიკისა და FMCG საცალო ვაჭრობაში. დიდი მონაცემების ანალიტიკამ, მიწოდების ჯაჭვის მართვა ტრადიციული, ხაზოვანი პროცესებიდან გადააქცია ურთიერთდაკავშირებულ, მონაცემებზე დაფუძნებულ ეკოსისტემებად, რომლებიც ზრდის გამჭვირვალობას, ეფექტიანობას და მომხმარებელზე რეაგირების სისწრაფეს.

მოცემული კვლევა მიმოიხილავს აღნიშნული სექტორების ურთიერთკავშირს, განსაკუთრებული აქცენტით ისეთ გარდამავალ ეკონომიკებზე, როგორცაა საქართველო, სადაც ციფრული ტრანსფორმაცია სულ უფრო მეტად ხდება პრიორიტეტული.

გიგ ეკონომიკა გარდაქმნის შრომას ლოჯისტიკას, განსაკუთრებით „ბოლო მილის“ მიწოდებაში, საწყობის მართვასა და მოთხოვნაზე ორიენტირებულ საცალო სერვისებში, სადაც ისეთი პლატფორმები, როგორცაა *Walt* და *Glovo*, ქმნიან მოქნილ შრომით ბაზრებს და ცვლიან მომხმარებლის ქცევას.

საზღვაო ლოჯისტიკა, რომელიც გლობალური ვაჭრობის 80%-ზე მეტს საქონელ ბრუნვას ქმნის, მნიშვნელოვან ცვლილებებს განიცდის პორტის საკომუნიკაციო სისტემებისა და რეალურ დროში მონაცემთა პლატფორმების დანერგვით, რაც ხელს უწყობს საერთაშორისო ვაჭრობის გამარტივებას. ამავდროულად, FMCG საცალო ვაჭრობა მოითხოვს სწრაფ ადაპტირებას ომნიჩანელურ მოდელებზე, ელექტრონული მონაცემთა გაცვლის სისტემებზე (EDI), ხელოვნურ ინტელექტზე დაფუძნებულ პროგნოზირებასა და ინვენტარის ავტომატიზაციაზე, რაც ხელს უწყობს მომხმარებლის მზარდი მოლოდინების უკეთეს დაკმაყოფილებას. საქართველოში ეს ცვლილებები მკაფიოდ გამოიხატება ბრენდირებული საცალო ქსელების გაფართოებაში და ელექტრონული კომერციის ზრდაში.

აკადემიური ლიტერატურის, საერთაშორისი ანგარიშების და საქართველოს სექტორული მონაცემების სინთეზის გზით, კვლევა წარმოაჩენს როგორც შესაძლებლობებს, ასევე გამოწვევებს მიწოდების ჯაჭვის გაციფრულების პროცესში. ნაშრომი ავითარებს კონცეპტუალურ ჩარჩოს ციფრული მიწოდების ჯაჭვების სექტორებს შორის კოორდინაციის უკეთ გასაგებად. წინამდებარე ნაშრომში განიხილება, თუ როგორ ხდება აღნიშნული სექტორების ერთმანეთთან თანაჯაჭვადობა და ერთმანეთზე დამოკიდებულება ტექნოლოგიური ტრანსფორმაციის ფონზე, რაც, თავის მხრივ, აყალიბებს ახალ ბიზნეს მოდელებს, ზრდის ეფექტიანობას და აუმჯობესებს მომხმარებლის გამოცდილებას. განსაკუთრებული ყურადღება ეთმობა კოორდინაციას, რეალურ დროში მონაცემების გამოყენებასა და ციფრულ ინოვაციებზე დაფუძნებულ სტრატეგიებს.

საკვანძო სიტყვები: ციფრული ტრანსფორმაცია, მიწოდების ჯაჭვი, გიგ ეკონომიკა, საზღვაო ლოჯისტიკა, FMCG საცალო ვაჭრობა.

JEL კლასიფიკაცია: O33, R41, L81.

Introduction and review of literature

The transformation of supply chains through digital technologies has become essential in an increasingly complex, globalized market. From algorithmic delivery platforms to AI-based inventory systems and smart ports, digital tools are no longer optional—they are a prerequisite for resilience and agility (Ivanov D. , 2020) (Capgemini Research Institute, 2020.) In the FMCG retail sector, it enhances responsiveness and traceability, while in maritime logistics, innovations like digital twins and blockchain support operational efficiency. However, the adoption of these technologies often faces challenges categorized under the TOE framework, which highlights three key dimensions: technological factors (e.g., system complexity, compatibility), organizational factors (e.g., leadership, resource readiness), and environmental factors (e.g., regulatory pressure, market dynamics). (Tornatzky & & Fleischer, 1990) This article aims to conceptualize the digital transformation of the global supply chain through the interplay of the gig economy, maritime logistics, and FMCG retail domains—with particular empirical grounding in Georgian logistics activity. It makes two contributions: A conceptual synthesis of academic literature across these domains, highlighting key digital technologies and the inter-organizational interplay; And a framework for coordination, focusing on synchronization, visibility, and platform-based governance across sectors.

Methodology

This study employs a qualitative, exploratory methodology grounded in literature synthesis and conceptual analysis. The approach includes:

- Systematic literature review across peer-reviewed journals, international organization reports (e.g., UNCTAD), and sector-specific studies on digital transformation in supply chain management, maritime logistics, gig economy labor, and retail digitization.
- Comparative sector analysis to identify points of convergence and divergence between the gig economy, maritime logistics, and FMCG retail within the digital supply chain context.
- Contextual application using national data from Georgian sources, including reports by Galt & Taggart, PMCG, TBC Capital, The Ministry of Economy and Sustainable Development of Georgia.

This methodology enables both an academic contribution to supply chain digitalization theory and practical recommendations for stakeholders operating in transitional markets like Georgia.

Results

Digital transformation refers to the integration of digital technologies into all facets of business operations, fundamentally altering value creation, communication, and decision-making. In supply chain management (SCM), digital transformation entails the application of advanced technologies to improve visibility, responsiveness, agility, and resilience (Morita, 2020) (Ivanov D. D., 2019).

This transformation is not merely about digitization (analog-to-digital conversion) or digitalization (process automation), but rather about a holistic transformation of supply chain structures and mindsets through the adoption of interconnected technologies such as Artificial Intelligence (AI), Internet of Things (IoT), blockchain, robotics, and advanced analytics (Schrauf, 2016). These technologies enhance the supply chain's capacity to function in volatile, uncertain, complex, and ambiguous (VUCA) environments.

Globally, digitally transformed supply chains exhibit 20–30% faster decision-making and up to 50% better forecast accuracy (Capgemini., 2020). According to McKinsey (2022), companies that aggressively digitize their supply chains can expect a 3.2% revenue growth and a 2.3% reduction in supply chain costs over 3 years. (McKinsey, 2017)

In Georgia, digital transformation in the supply chain is emerging as a national priority. The government, with support from international partners such as GIZ and USAID, is promoting logistics modernization and digital skills development. For instance, the 2022 National Digital Economy Strategy of Georgia emphasizes smart infrastructure, digital platforms for customs/logistics, and integration into international supply chain networks (PMCG/USAID, 2023)

The gig economy, characterized by short-term, task-based labor often facilitated through digital platforms, has become an increasingly prominent component of the global and local logistics landscape. In supply chains, gig workers are now utilized for last-mile delivery, temporary warehousing, inventory tagging, and data annotation (MIT Press. Sundararajan, 2016) (Stefano, 2016)

Gig-based delivery platforms (e.g., Glovo, Wolt) operating in Georgia and other emerging markets exemplify how flexible labor models respond to rising consumer demand for instant delivery and on-demand service. In 2020, Georgia's food delivery sector generated approximately GEL 167 million, representing a threefold increase over 2019. The number of delivery orders surged by 146%, reaching around 5.3 million, with an average basket size of GEL 31.5. On average, each user placed about six orders per year (GALT&TAGGART, E-commerce in Georgia, 2021 July). Market share is highly concentrated: Glovo and Wolt together accounted for about 95% of the Georgian food delivery market as of 2020 (GALT&TAGGART, E-commerce in Georgia, 2021 July). As of early 2024, Wolt Georgia employed around 7,000 partner couriers, providing delivery from over 1,500 partner restaurants and 2,000 retail stores across five major cities (<https://goldenbrand.ge/>, 2023). In 2021, Wolt Georgia's local revenues reached GEL 34.5 million, while Glovo Georgia recorded GEL 33.9 million. Wolt paid couriers GEL 25.4 million, compared to Glovo's GEL 13.6 million. (BM.GE, 2022).

Maritime logistics—accounting for over 80% of global trade by volume—is undergoing substantial digital transformation (UNCTAD, 2022). Smart port technologies, including IoT-based sensors, autonomous container handling, digital twins, and AI-powered scheduling, are improving visibility, throughput, and environmental compliance.

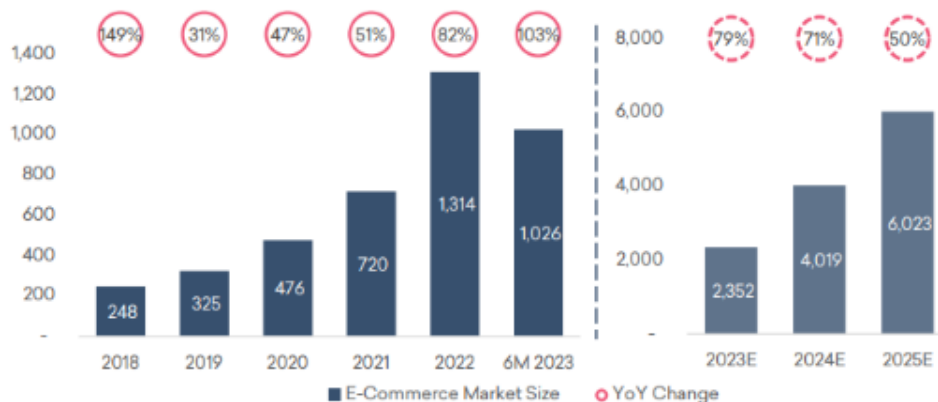
The Port of Poti and Port of Batumi in Georgia are undergoing a digital transformation to enhance their competitiveness along the Trans-Caspian International Transport Route (TITR). Supported by international donors and private stakeholders, the Georgian government has initiated key projects including the implementation of a **National Maritime Single Window (NMSW)** and the development of a **Port Community System (PCS)**. These platforms aim to improve logistics transparency, port efficiency, and

cross-border data exchange in alignment with global best practices. Moreover, Georgia, in partnership with Kazakhstan and Azerbaijan, is part of a multilateral effort to establish a unified **digital corridor** that integrates real-time data flows, eliminates administrative bottlenecks, and enables seamless cargo movement along TITR (TITRAssociation, 2022). The World Bank is also supporting Georgia in designing a digital logistics platform aimed at modernizing trade corridors in the South Caucasus region. (UNESCAP & United Nations Economic and Social Commission for Asia and the Pacific, 2023). Scholarly analysis (Heilig, 2017); (Notteboom, 2021). Supports that digitalization in maritime logistics improves port-centric value creation and intermodal efficiency, especially when integrated with national transport and trade facilitation policies.

E-commerce businesses heavily rely on internet connectivity to engage and convert customers. Access to the internet enables users to explore product offerings, compare prices, read reviews, and make informed purchasing decisions. Without it, the reach and functionality of e-commerce platforms would be significantly constrained. In Georgia, internet penetration is relatively high compared to global standards, creating favorable conditions for the development of the digital economy. As of 2022, 88% of individuals in Georgia had internet access, surpassing the global average of 66% and closely aligning with the European average of 89%. This widespread connectivity enhances the potential customer base for local e-commerce businesses. However, regional disparities exist: Tbilisi reports the highest internet penetration at 95%, while more remote areas such as Racha-Lechkhumi (72%) and Mtskheta-Mtianeti (77%) exhibit lower levels of access (TBCCapital, 2023, August).

As it shown on the figure #1 Georgia’s e-commerce market has experienced rapid expansion, with its estimated market size exceeding GEL 1.3 billion in 2022, reflecting an 82% year-on-year growth. This significant increase highlights rising consumer demand for online shopping, likely driven by evolving consumer preferences, greater convenience, and a broader range of available products. The sharp growth also suggests that new entrants are gaining market traction faster than in previous years. Furthermore, the surge in sales points to growing consumer confidence in online transactions, particularly regarding payment security, product quality, and delivery reliability. Despite this progress, the share of local businesses in total e-commerce transactions remains relatively low, as cross-border purchases still dominate. This trend implies that many consumers continue to rely on international platforms due to better pricing or the unavailability of certain products and services in the domestic market. (TBCCapital, 2023, August)

Figure #1 Estimated Georgian E-Commerce Market Size (Million GEL)

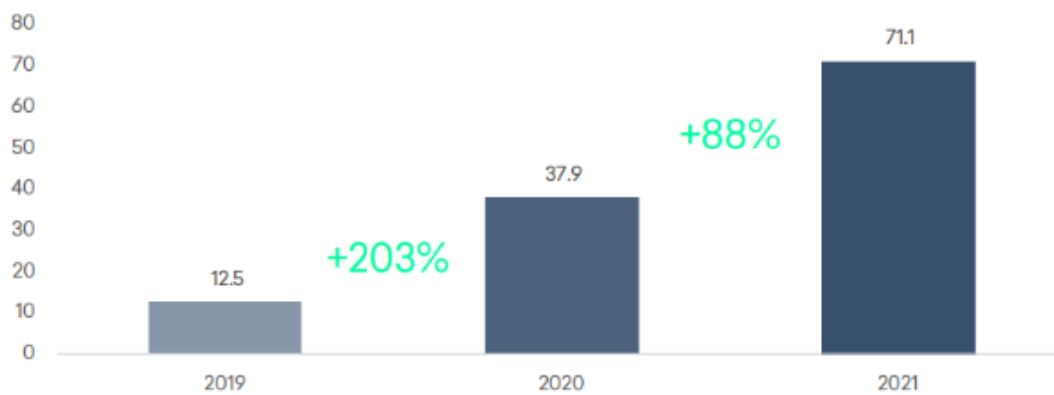


Source: TBC CAPITAL 2023

The fast-moving consumer goods (FMCG) sector is a key driver of digital supply chain adoption. Retailers now rely on real-time inventory tracking, electronic data interchange (EDI), AI-based demand forecasting, and Omni channel platforms to meet rising consumer expectations. In Georgia, the expansion of large retailers has accelerated investment in supply chain digitalization.

In recent years, **food delivery services in Georgia have witnessed substantial growth**, significantly shaping the broader e-commerce ecosystem and influencing consumer behavior. The **convenience and accessibility** provided by these platforms have created new opportunities for both consumers and businesses. The onset of the **COVID-19 pandemic in 2020** acted as a major catalyst, leading to an accelerated adoption of delivery services. During that year, both the **transaction volume and the number of transactions demonstrated triple-digit monthly growth**. While the growth trajectory began to stabilize in 2022—with a **38% annual increase in transaction volume**—data from the **first half of 2023 indicates a continued 40% year-on-year rise** (Figure #2). Notably, the widening gap between volume and transaction count suggests an increase in the **average value of each order**. This rising demand has directly translated into significant revenue gains for domestic delivery service providers, who reported a **203% income increase in 2020**, followed by a sustained **88% growth in 2021**.

Figure #2



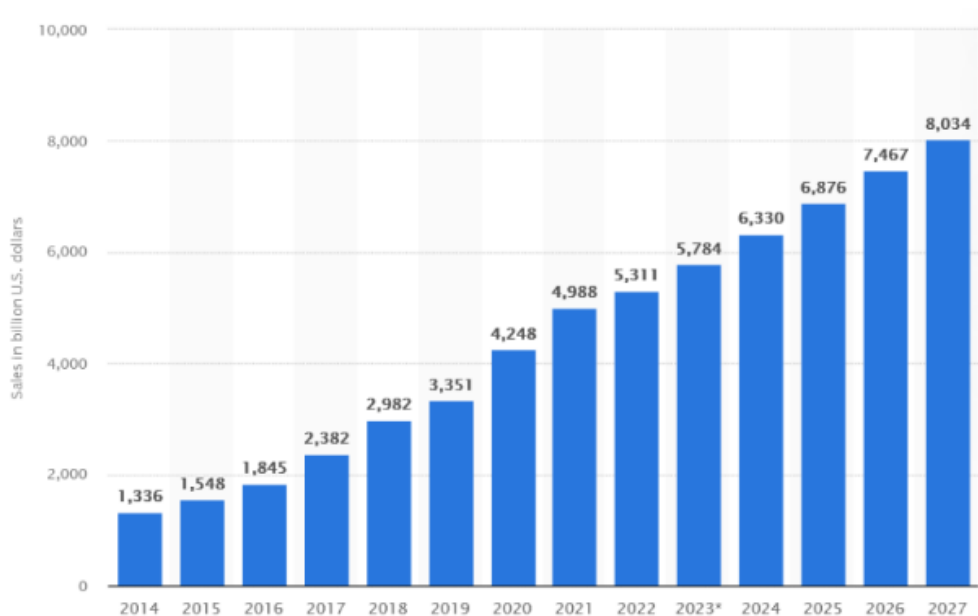
Source: GALT&TAGGART, FMCG sectorial overview, 2024 December

According to Galt & Taggart (GALT&TAGGART, FMCG sector, 2024 December), **Georgia's FMCG market is projected to grow at an average annual rate of 8.0% between 2025 and 2028**, primarily driven by the expected increase in consumer purchasing power. **Branded retail chains** are forecasted to expand at a faster pace than other retail formats, supported by geographic expansion, strategic development initiatives, and the continued rise of e-commerce. The **branded segment alone is expected to grow by 14.8% annually** during 2025–2028, following a **24.5% growth during 2021–2024**. As a result, the **market share of branded chains is projected to rise from 40.7% to 52.0% by 2028**, underscoring their growing dominance in the Georgian FMCG retail landscape.

Figure # 3 illustrates the global growth trajectory of **retail e-commerce sales between 2014 and the projected year 2027**, measured in **billion U.S. dollars**. The data shows a consistent upward trend, with global sales rising from **\$1.336 trillion in 2014** to an estimated **\$8.034 trillion by 2027**. This reflects the rapid digitalization of retail and the increasing reliance on online channels for consumer purchases. The most significant growth occurs between **2019 and 2021**, likely influenced by the acceleration of e-commerce

adoption during the COVID-19 pandemic. The trend underscores the expanding role of e-commerce as a dominant force in global retail markets.

Figure # 3 Retail e-commerce sales worldwide from 2014 to 2027 (in billion U.S. dollars)



Source: Torres David, Machine Learning for Predicting Online Shoppers' Purchase Intentions (Torres, 2024)

As of 2022, **e-commerce accounted for approximately 3.5% of total FMCG sales in Georgia**, indicating a relatively low but growing share. For comparison, markets like **South Korea (11.7%)**, the **United Kingdom (8.9%)**, and **China (8.0%)** reported significantly higher e-commerce penetration in the FMCG segment. Georgia's position is similar to other emerging markets such as **Turkey (3.1%)** and **Hungary (2.5%)**, suggesting room for expansion.

In Georgia, FMCG e-commerce growth is primarily concentrated in **food, hygiene, and personal care categories**. Market forecasts anticipate a considerable increase in online sales share by **2028**, driven by structural changes in consumer behavior and technological adoption.

This gap is particularly relevant in the context of Georgia's ambitions to integrate digital technologies such as Electronic Data Interchange (EDI), Internet of Things (IoT), data analytics, and AI-based forecasting within its logistics and retail sectors. (Taggart., 2024, February)

Academic literature (Grewal, 2021) emphasizes that digital retail supply chains contribute to agility and customer-centricity, particularly in markets experiencing rapid urbanization and digital adoption—conditions that mirror Georgia's current economic development.

Thus, while Georgia demonstrates strong progress in building digital infrastructure, targeted policies and investments in human capital are needed to enhance the adoption and impact of digital transformation initiatives. Strengthening digital competencies across the workforce would directly contribute to improved

operational efficiency, enhanced system integration, and better alignment with global supply chain practices in strategic sectors such as FMCG retail and maritime logistics.

The gig economy, maritime logistics, and FMCG retail—though traditionally siloed—are now increasingly interlinked through digital ecosystems. Theoretical models such as the Digital Supply Chain Integration Framework (Ivanov D. , 2020) and the Service-Dominant Logic (Vargo, 2004) provide a conceptual basis for understanding this convergence.

In practice, this convergence is visible in the formation of digital platforms where:

- Consumers order FMCG goods online (retail),
- Products are sourced internationally (maritime logistics),
- Deliveries are completed by gig workers (last mile).

Such interconnectedness demands interoperable systems, real-time data exchange, and platform governance—areas in which Georgia is actively advancing through initiatives like the Digital Silk Road and regional logistics innovation hubs.

Globally, gig economy platforms are transforming last-mile delivery and temporary logistics by enabling ad-hoc labor allocation via algorithmic management systems (MIT Press. Sundararajan, 2016) (Stefano, 2016) In Georgia, app-based platforms like Wolt, Glovo and Bolt Food dominate urban delivery services. In the supply chain context, gig platforms offer flexible capacity for peak-demand periods in FMCG delivery and warehousing operations. Yet, system integration requires interoperable IT interfaces, data-sharing protocols, and mechanisms for quality control and worker support. Maritime logistics undergirds a large share of international trade, and digital evolution in port operations has gained traction worldwide through IoT, block chain, AI, and digital twins (Heilig, 2017). Such technologies enhance cargo tracking, optimize berth scheduling, and support environmental compliance and predictive maintenance.

Communication among stakeholders via Port Community Systems (PCS), electronic customs, and emerging digital corridor platforms enhances transparency and coordination.

On the demand side, FMCG retail globally increasingly relies on EDI, demand forecasting analytics, and Omni channel logistics to manage perishable stock and high turnover (Grewal, 2021). Integration with logistics and delivery partners is essential to synchronizing inventories and last-mile fulfillment.

In Georgia, modern chains invest in ERP and inventory automation systems, with a growing share adopting third-party delivery and e-commerce integrations. High internet access and rapid growth in online commerce have created fertile ground for digital retail ecosystems. Practically, e-commerce orders trigger digital demand signals shared with logistics operators (ports, warehouses), while gig workers fulfill last-mile delivery—a triadic connectivity enhancing speed and responsiveness.

Table #1

Sector	Digital Drivers	Key Linkages
Gig Economy	Platform algorithms, mobile apps	Last-mile delivery, warehousing, workforce flexibility
Maritime Logistics	IoT, blockchain, digital twins	Port-to-freight linkage, customs, intermodal synchronization
FMCG Retail	ERP, EDI, real-time analytics	Demand forecasting, e-commerce fulfillment, inventory sync

Table #1 shows the synergy among these sectors occurs when consumer demand (FMCG retail) signals are transmitted through digital platforms to maritime logistics and ultimately fulfilled via gig labor—forming a digitally orchestrated, end-to-end supply chain network

Digital technologies serve as the backbone of interconnected supply chains by enabling coordination, real-time visibility, data-driven decision-making, and system-wide optimization. In the nexus of the gig economy, maritime logistics, and FMCG retail, these technologies act as enablers of platform economies, smart infrastructure, and predictive analytics.

Big Data analytics allows supply chain actors to gather, process, and interpret vast volumes of data—ranging from customer demand patterns to delivery logs and port throughput. It transforms raw, fragmented data into actionable intelligence for inventory forecasting, delivery route optimization, and performance benchmarking; (Waller, 2013) (Choi, 2018)

IoT is essential to establishing “smart” systems within supply chains—connecting physical assets (vehicles, containers, inventory) to digital interfaces for real-time monitoring and traceability (Ben-Daya, 2019). In maritime logistics, IoT sensors enable dynamic vessel positioning, temperature control for perishables, and predictive maintenance for port cranes and trucks. In the gig economy, courier-tracking via GPS is foundational to performance monitoring and customer transparency. AI applications in supply chains range from autonomous vehicle navigation to machine learning-based inventory forecasting, customer sentiment analysis, and risk prediction models (Ivanov D. D., 2019) (Wamba-Taguimdje, 2020) AI strengthens supply chain agility and responsiveness by learning from data patterns and optimizing decision rules. In Georgia’s FMCG sector, AI is increasingly used to:

- Predict purchasing behavior using POS data;
- Automate dynamic pricing in online retail;
- Allocate warehouse resources based on expected volume;
- Forecast high-demand SKUs in urban supermarkets.

Meanwhile, logistics platforms are exploring AI-powered dashboards to estimate container delays and to optimize customs clearance timing based on historical congestion at border crossings.

Blockchain technology enables secure, tamper-proof record keeping, ideal for multi-stakeholder supply chain environments where information must be shared but not necessarily controlled by a single entity (Kshetri, 2018). Key use cases include:

- Smart contracts for payment automation;
- Provenance tracking for sensitive goods (e.g., pharmaceuticals, food);
- Streamlined documentation (e.g., bills of lading, customs forms).

Table #2

Technology	Key Functions	Application in Georgia
Big Data Analytics	Demand forecasting, route optimization, inventory planning	ERP analytics in FMCG;
Internet of Things (IoT)	Real-time tracking, asset monitoring, predictive maintenance	IoT in port container tracking; GPS delivery
Artificial Intelligence (AI)	Automation, predictive analytics, dynamic pricing	Retail AI for SKU forecasting, warehouse optimization, customs timing

Here is the Table # 2 summarizing the Role of Digital Technologies in the Integrated Supply Chain, including global functions and specific applications in Georgia.

Conclusions

The digital transformation of global supply chains is not a linear change but a systemic evolution that requires rethinking how goods, information, and labor are coordinated across sectors. This paper has

examined how three initially distinct domains—gig economy, maritime logistics, and FMCG retail—are becoming increasingly interdependent within digitally integrated supply chain ecosystems.

Technologies such as big data analytics, the Internet of Things (IoT), artificial intelligence (AI), and blockchain not only enhance individual sectors but fundamentally reshape how they interact—enabling real-time data sharing, predictive control, and customer-centric coordination. However, this convergence is neither automatic nor seamless; it introduces a complex array of challenges including system interoperability, cybersecurity, labor equity, infrastructure, and regulatory clarity.

In Georgia, the digital transformation is underway but remains uneven. While progress has been made in areas such as retail automation, gig platform expansion, and initial port digitization, challenges persist in workforce preparedness, cross-sector integration, and legal frameworks. Nevertheless, Georgia's strategic location and ambition for digital advancement make it a promising environment for piloting regional digital corridor models.

A key contribution of this paper lies in the conceptual integration of gig work, smart logistics, and digital retail into a unified digital supply chain logic, providing insight into how emerging economies like Georgia can navigate this transition through coordinated, inclusive, and innovation-driven strategies.

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