CLASSIFICATION OF METHODS TO ENHANCE SUPPLY CHAIN MANAGEMENT EFFICIENCY

Vitalii Dzhenkov[1]

DOI: https://doi.org/10.30525/978-9934-26-601-0-12

Within the scope of this research, an attempt has been made to systematize and generalize methods for enhancing the efficiency of supply chain management. The proposed approach is based on the identification of key characteristics reflecting the evolution of management paradigms, the level of technological maturity of enterprises, and their degree of adaptability to digital transformation. Based on the conducted analysis, an authorial classification of methods has been developed, which is presented in a visual format and summarized in Table 1.

Table 1

Classification of methods for improving supply chain management efficiency

Classification Criterion	Method Types	Description
1. By technological complexity	– Basic (Lean, JIT, ABC/XYZ) – Intermediate (CRM, Excel-based analytics) – Advanced (AI, Big Data, Digital Twins)	Ranges from manual methods to intelligent approaches leveraging advanced digital technologies
2. By level of automation	– Manual – Semi-automated – Automated / Autonomous	Reflects the degree of dependence on human intervention in processes
3. By functional areas	– Demand forecasting – Procurement – Inventory management – Logistics – Risk management – Partner relationship management	Methods cover the key phases of the supply chain
4. By degree of digital transformation	– Document-based (spreadsheets) – Integrated (ERP, SCM) – Intelligent (AI, ML, Big Data) – Innovative (IoT, blockchain, RPA, Digital Twin)	Ranges from basic computerization to a fully integrated digital ecosystem

[1] Taras Shevchenko National University of Kyiv, Ukraine

Let us examine in more detail the different approaches to classifying methods for improving supply chain management efficiency.

By degree of technological sophistication. Methods for enhancing supply chain efficiency can be grouped into three levels of technological complexity. At the most basic level are traditional approaches focused on organizational and process improvements without significant digital integration (e.g., Lean management, Just-in-Time, ABC/XYZ analysis, Kanban). These methods optimize logistics flows and reduce inventory but do not incorporate automated analytics. Mid-level methods combine classical tools with basic digital solutions, such as spreadsheet software, CRM systems, or selected ERP modules. This allows for electronic record-keeping and basic analytical processing; however, decision-making remains largely manual. The highest level comprises advanced technological methods that integrate modern information systems, artificial intelligence, machine learning, the Internet of Things (IoT), and digital twins. These approaches enable real-time management, demand forecasting, route optimization, and adaptive inventory control, thereby ensuring the strategic resilience of supply chains [2].

The classification of supply chain management methods **by level of automation** reflects the degree of dependence on human intervention. At the initial stage, manual methods are employed, relying primarily on individual managerial decisions and traditional accounting and control tools. Further development involves semi-automated methods, where certain operations are supported by information systems, while key functions remain under managerial control. The highest level encompasses fully automated and autonomous systems, in which management processes are largely delegated to digital platforms, intelligent algorithms, and artificial intelligence systems [4]. This approach minimizes the influence of the human factor, enhances the speed and accuracy of decision-making, and increases adaptability to changes in the external environment.

The classification of supply chain management methods **by functional areas** allows for tracing their specific application across different stages of the logistics process and management responsibility zones. A key area is demand management and forecasting, which relies on both traditional statistical techniques and modern machine learning algorithms and neural networks capable of accounting for seasonal fluctuations, consumer behavior patterns, and external economic factors. Equally important is procurement and supply planning, encompassing the optimization of order volumes and timing, assessment of supplier reliability, and the use of digital platforms for order coordination and execution monitoring. Inventory management integrates classical methods such as ABC/XYZ analysis and EOQ models with advanced intelligent algorithms, enabling adaptive adjustment of order levels in response

to demand changes and logistical risks [1]. In the realm of transportation and logistics management, the role of GPS technologies, TMS systems, and real-time routing solutions is increasingly significant, ensuring transparency and predictability of shipments. Amid growing external uncertainty, risk management becomes particularly critical, implemented through scenario modeling, digital twins, and the development of crisis-response strategies. Finally, partner relationship management, involving SRM systems and collaborative planning platforms, plays a central role in fostering trust, synergy, and overall supply chain efficiency [3].

By the degree of digital transformation, methods for improving supply chain management efficiency can be grouped according to the depth of digital technology integration into business processes.

At the most basic level are information and document-based methods, which involve transitioning from paper-based to electronic forms of accounting, reporting, and document management. The use of electronic document management accelerates information exchange, reduces the risk of errors, and establishes a unified information base, serving as the initial stage of enterprise digitalization [1].

The next level comprises integrated digital management platforms (ERP, SCM, CRM), enabling centralized coordination of key business processes – from procurement and production to logistics and customer interaction. These platforms enhance decision-making consistency, reduce time expenditures, and optimize resource utilization within a unified digital ecosystem.

At a more advanced stage are intelligent systems based on artificial intelligence, predictive analytics, and automated decision-support tools. Their application not only automates routine operations but also allows the generation of predictive models, identification of hidden patterns in large datasets, and dynamic adaptation of management strategies.

The highest level of digital maturity is characterized by the implementation of innovative technologies that fundamentally transform supply chain operations. These include the Internet of Things (IoT), cloud services, blockchain, digital twins, and robotic process automation. They enable the integration of physical and digital assets, enhance transparency and security of transactions, and allow real-time modeling of logistics systems, thereby creating resilient, adaptive, and highly efficient supply chains in the context of the digital economy [3].

In summary, the classification of supply chain management methods by technological complexity, functional areas, level of automation, and degree of digital maturity allows for tracing the evolution of managerial approaches from basic organizational practices to advanced, high-tech systems. A key trend in the current stage of development is the increasing role of intelligent methods

based on information technologies, artificial intelligence, and big data analytics. These approaches facilitate the transition from traditional reactive models to proactive management, enhance the adaptability of supply chains in turbulent environments, and strengthen the strategic resilience of businesses. Accordingly, the intellectualization of supply chain management can be regarded as a critical factor in enhancing enterprise competitiveness in the digital economy.

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