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Enhancing Multi-Echelon Home Improvement Supply Chain Responsiveness Through Machine Learning-Enabled Inventory Segmentation and Positioning

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Abstract

In a highly competitive environment where inventory management is pivotal in reducing costs and improving service levels, this research develops a data-driven methodology for inventory segmentation and positioning within a multi-tier supply chain. The study focuses on a business unit of a leading Latin American company specializing in the manufacturing and retailing of household products. Stock keeping units (SKUs) were segmented using unsupervised machine learning algorithms and dimensionality reduction techniques, classifying products based on demand behavior and supply characteristics. Based on this segmentation, an inventory positioning strategy was defined by assigning each SKU to the most appropriate tier of the distribution network, regional distribution centers, urban last-mile facilities, and retail stores. Each tier was aligned with a tailored push-pull strategy according to the predictability and variability of SKU demand, enabling differentiated product flows to operate efficiently within a shared physical infrastructure. The methodology was applied to 701 critical SKUs. Before implementation, the network showed substantial imbalances: 81% of inventory was held in stores, 17% in urban last-mile centers, and only 2% in regional DCs, resulting in excessive overstock, slow turnover, and limited responsiveness. Following implementation, inventory was reallocated to 58% in regional DCs, 8% in urban last-mile centers, and 34% in stores. This transformation improved service levels, reduced lead times, and increased inventory efficiency. The results demonstrate the strategic potential of integrating machine learning into supply chain design to enable more responsive, efficient, and cost-effective operations.

Keywords

Supply Chain Segmentation, Inventory Positioning, Unsupervised Learning, home improvement industry.