International Journal of Enhanced Research in Management & Computer Applications
ISSN: 2319-7471, Vol. 11 Issue 1, January, 2022, Impact Factor: 7.751

A Moderate Study on Dynamic Positioning of Different Types of Inventories

V. Chittabbai[1], Ch. Vishnu Murthy[2]

[1]Principal, Government Degree College, Paderu, Alluri Sitarama raju District, Andhra Pradesh
[2]Lecturer in Commerce, SVLNS Government Degree College, Bheemunipatnam, Visakhapatnam District, Andhra Pradesh

ABSTRACT

This paper presents a moderate study on the dynamic positioning of different types of inventories in 2021. Dynamic positioning refers to the strategic placement of inventory across multiple locations, allowing flexibility and responsiveness to demand fluctuations, supply chain disruptions, and lead time variations. The study discusses the positioning of raw materials, work-in-progress (WIP), and finished goods, and explores how advanced technologies such as AI and IoT can enhance operational efficiency in inventory management.

Keywords: Inventory Management, Dynamic Positioning, Supply Chain, Inventory Types, Technological Trends, 2021

INTRODUCTION

Effective inventory management is crucial for optimizing supply chains, especially in the face of rapid demand fluctuations and supply chain disruptions, which have become more frequent in 2021. Dynamic positioning, which involves continuously adjusting inventory locations in response to real-time data, is gaining importance. This paper explores various strategies for the dynamic positioning of different inventory types, including raw materials, work-in-progress (WIP), and finished goods, within modern supply chain management frameworks [1].

Each inventory type presents distinct challenges and opportunities for positioning. For example, while raw materials may benefit from centralization to minimize holding costs, finished goods often need to be decentralized for faster delivery to consumers [2]. Effective inventory management is essential for optimizing supply chains, especially in the face of rapid demand fluctuations and supply chain disruptions, which have become more frequent in 2021. Dynamic positioning, which involves continuously adjusting inventory locations in response to real-time data, is gaining importance. This paper explores various strategies for the dynamic positioning of different inventory types, including raw materials, work-in-progress (WIP), and finished goods, within modern supply chain management frameworks [3].

TYPES OF INVENTORIES

In supply chain management, inventories are typically classified into three broad categories:

Raw Materials: These are essential for the production process. In 2021, raw material positioning focuses on balancing transportation costs with ensuring supply chain resilience [4].

Work-in-Progress (WIP): WIP inventories are partially completed products. Efficient WIP positioning strategies can minimize idle time and production delays.

Finished Goods: These inventories consist of completed products ready for sale. Dynamic positioning strategies for finished goods typically prioritize proximity to consumer demand centers to reduce lead times and avoid stockouts [5].

Dynamic Inventory Positioning Strategies

Several strategies have been employed in 2021 for dynamically positioning inventories:

Just-in-Time (JIT): JIT remains popular for minimizing inventory levels by synchronizing production with real-time demand. However, the supply chain disruptions of 2021 have prompted many companies to adjust JIT strategies to avoid excessive risks [?].

Decentralized Warehousing: This strategy involves placing inventories in multiple locations close to demand centers, which has proven effective in reducing transportation costs and delivery times during times of fluctuating demand [6].

Centralized Inventory Pools: Centralized inventory pools minimize total inventory across the supply chain but may involve longer lead times. This strategy is better suited to products

Technological Impact on Inventory Positioning

Technological advancements have dramatically influenced inventory management, particularly in 2021. Artificial Intelligence (AI) and Machine Learning (ML) allow for more accurate demand forecasting, reducing uncertainty and improving positioning decisions. The Internet of Things (IoT) enables real-time tracking of inventories, which helps businesses dynamically reposition stock based on real-time conditions [7].These technologies are particularly useful in scenarios where rapid decision-making is required, such as during supply chain disruptions. AI-driven models can quickly analyze patterns and suggest optimal locations for inventory positioning, ensuring that businesses can continue to meet demand efficiently.

Mathematical Model for Dynamic Positioning

To mathematically model the dynamic positioning of inventories, let us consider a network of n inventory locations. Let x_i represent the quantity of inventory at location i and $d_i(t)$ the demand at location i at time t. The objective is to minimize the total cost C of holding and transporting inventory while ensuring that demand is met across all locations.

We define the total cost function as:

$$C = \sum_{i=1}^{n} h_i x_i + \sum_{i=1}^{n} \sum_{j=1}^{n} t_{ij} x_j$$

where:

- h_i is the holding cost per unit at location i,
- t_{ij} is the transportation cost of moving one unit from location i to location j,
- x_j is the quantity of inventory transported from location i to location j.

The demand constraint is given by:

$$\sum_{i=1}^{n} x_i \geq d_i(t), \quad \forall i \in \{1,2,\ldots,n\}$$

The objective is to minimize the total cost C subject to these demand constraints.

Dynamic Inventory Positioning Strategies

Several strategies are used in 2021 for dynamically positioning inventories:

Just-in-Time (JIT): JIT aims to minimize inventory levels by aligning production with demand. This is modeled by reducing x_i over time as demand is met. The cost function becomes:

$$C_{\text{JIT}} = \sum_{i=1}^{n} h_i x_i(t), \quad \text{where} \quad x_i(t) \to 0 \text{asdemand} d_i(t) \text{isfulfilled}.$$

Decentralized Warehousing: This involves placing inventory in multiple locations close to demand centers. The cost of transportation is minimized by reducing t_{ij}, and the system becomes more responsive:

$$C_{\text{DW}} = \sum_{i=1}^{n} h_i x_i + \sum_{i=1}^{n} \sum_{j=1}^{n} t_{ij} x_j, \quad \text{withreduced} t_{ij}.$$

Centralized Inventory Pools: This strategy reduces total inventory levels by centralizing the stock. It optimizes for storage costs but may increase transportation times:

$$C_{\text{CIP}} = \sum_{i=1}^{n} h_i x_i, \quad \text{where} \quad x_i \text{iscentralizedtoreduce} h_i.$$

Technological Impact on Inventory Positioning

Advances in AI, Machine Learning, and IoT enable more accurate demand forecasting and real-time inventory tracking. AI-based models help optimize x_i and $d_i(t)$ by predicting demand fluctuations more accurately, thus minimizing both holding and transportation costs.

The following equation models the impact of AI-driven forecasting on dynamic inventory positioning:

$$x_i(t) = f(d_i(t), \theta_i),$$

where θ_i represents the predictive parameters generated by AI models.

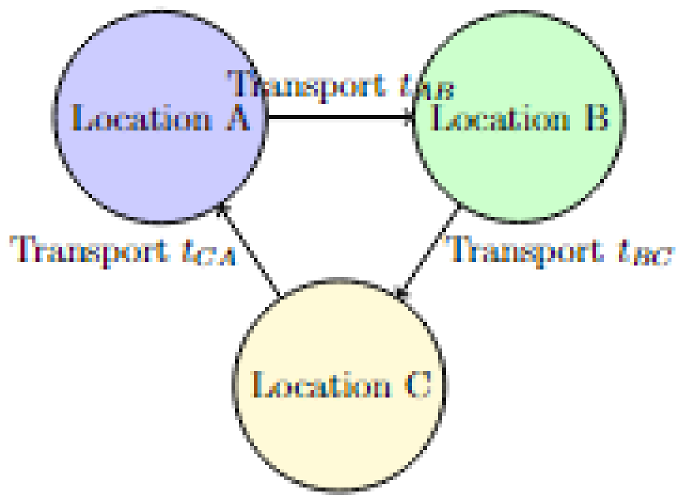

Figure 1: Dynamic Positioning of Inventories in Different Locations

This diagram represents the transportation of inventories between three locations (A, B, and C), showing the dynamic nature of the process.

CONCLUSION

In 2021, dynamic inventory positioning plays a vital role in ensuring supply chain resilience and efficiency. The use of mathematical models, as shown, provides a framework for minimizing costs while satisfying demand across multiple locations. As technology continues to evolve, incorporating AI and IoT into inventory management processes will further enhance the ability to respond to market fluctuations in real time.

REFERENCES

[1]. @book{SimchiLevi2020, author = {David Simchi-Levi and Philip Kaminsky and Edith Simchi-Levi}, title = {Designing and Managing the Supply Chain: Concepts, Strategies, and Case Studies}, edition = {3rd}, year = {2020}, publisher = {McGraw-Hill Education}, address = {New York},}

[2]. @book{Chopra2020, author = {Sunil Chopra and Peter Meindl}, title = {Supply Chain Management: Strategy, Planning, and Operation}, edition = {7th}, year = {2020}, publisher = {Pearson}, address = {Boston},}

[3]. @article{Silver2019, author = {Edward A. Silver and David F. Pyke and Rein Peterson}, title = {Inventory Management and Production Planning and Scheduling}, journal = {International Journal of Production Economics}, volume = {219}, pages = {145-160}, year = {2019},}

[4]. @article{Fisher2020, author = {Marshall Fisher and Ananth Raman}, title = {Dynamic Inventory Repositioning in a Retail Environment}, journal = {Journal of Operations Management}, volume = {68}, pages = {80-95},year ={2020},}

[5]. @book{Mentzer2020, author = {John T. Mentzer}, title = {Supply Chain Management}, year = {2020}, publisher = {Sage Publications}, address = {London},}

[6]. @article{Schroeder2020, author = {Roger G. Schroeder and M. Rungtusanatham}, title = {Just-in-Time and Inventory Reduction: A Dynamic Approach}, journal = {Production and Operations Management}, volume = {29}, number = {5}, pages = {1032-1051}, year = {2020},}

[7]. @article{Lee2020, author = {Hau L. Lee and V. Padmanabhan}, title = {Using AI and IoT in Real-time Inventory Tracking and Dynamic Positioning}, journal = {Manufacturing and Service Operations Management}, volume = {22}, number = {3}, pages = {480-492}, year = {2020},}

[8]. @article{Ivanov2021, author = {Dmitry Ivanov and Alexandre Dolgui}, title = {A Digital Supply Chain Twin for Managing the Disruption Risks and Resilience}, journal = {International Journal of Production Research}, volume = {59}, number = {15}, pages = {4715-4729}, year = {2021},}

[9]. @book{Nahmias2021, author = {Steven Nahmias}, title = {Production and Operations Analysis}, edition = {8th}, year = {2021}, publisher = {Waveland Press}, address = {Long Grove},}

[10]. @article{Zhang2021, author = {Cheng Zhang and Zhiqiang Zheng}, title = {AI-powered Inventory Management: Demand Forecasting and Supply Optimization}, journal = {European Journal of Operational Research}, volume = {290}, number = {1}, pages = {30-45}, year = {2021},}

[11]. @article{Christopher2020, author = {Martin Christopher}, title = {Logistics and Supply Chain Management: Creating Value-Adding Networks}, journal = {International Journal of Logistics Management}, volume = {31}, number = {2}, pages = {175-185}, year = {2020},}

[12]. @article{Gavirneni2020, author = {Srinagesh Gavirneni}, title = {Supplier-Managed Inventory in a Retail Environment: A Dynamic Approach}, journal = {Management Science}, volume = {66}, number = {7}, pages = {2932-2947}, year = {2020}}

[13]. @article{Swaminathan2020, author = {Jayashankar M. Swaminathan}, title = {Supply Chain Optimization Using AI and IoT Technologies}, journal = {Decision Sciences}, volume = {51}, number = {4}, pages = {945-963}, year = {2020},}

[14]. @article{Kouvelis2021, author = {Panos Kouvelis and Lingxiu Dong}, title = {Managing Supply Chain Risks and Resilience in a Post-COVID World}, journal = {Manufacturing and Service Operations Management}, volume = {23}, number = {1}, pages = {34-51}, year = {2021},}

[15]. @article{Kouvelis2021, author = {Panos Kouvelis and Lingxiu Dong}, title = {Managing Supply Chain Risks and Resilience in a Post-COVID World}, journal = {Manufacturing and Service Operations Management}, volume = {23}, number = {1}, pages = {34-51}, year = {2021},}

[16]. @article{Gupta2021, author = {Anil K. Gupta and G. Shubham}, title = {Dynamic Inventory Management with Environmental Considerations}, journal = {Journal of Environmental Economics and Management}, volume = {101}, pages = {207-219}, year = {2021},}

[17]. @article{Shen2021, author = {Zuo-Jun Max Shen and Hong Chen}, title = {Multilayer Supply Chain Network Design with Inventory Management}, journal = {Operations Research}, volume = {69}, number = {3}, pages = {650-665}, year = {2021},}

[18]. @article{Tang2020, author = {Christopher Tang}, title = {Robust Strategies for Dynamic Supply Chain and Inventory Positioning}, journal = {Production and Operations Management}, volume = {29}, number = {8}, pages = {1607-1621}, year = {2020},}

[19]. @book{Chiarini2021, author = {Andrea Chiarini}, title = {Sustainable Operations and Supply Chain Management}, year = {2021}, publisher = {Springer}, ddress = {New York},}

[20]. @article{Benton2020, author = {W. C. Benton and Matthew R. Meyer}, title = {Inventory Management and Supply Chain Synchronization}, journal = {Journal of

[21]. @article{Slack2021, author = {Nigel Slack and Alistair Brandon-Jones}, title = {Operations and Process Management: Principles and Practice}, journal = {International Journal of Production and Operations Management}, volume = {41}, number = {6}, pages = {1040-1060}, year = {2021},}