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MULTI-ECHELON INVENTORY OPTIMIZATION WITH SERVICE DIFFERENTIATION AT VOLVO GROUP

Step into the forefront of inventory management as we unveil a model developed to tackle the dynamic challenges of inventory control. This study challenges traditional multi-echelon modeling by integrating service differentiation and non-controllable retailers into a multi-echelon framework, showcasing significant reductions in inventory levels while upholding target service levels.

Inventory control plays a pivotal role in supply chain management, ensuring that adequate inventory levels are maintained across various organizational tiers to meet customer demands efficiently. These systems furnish decision-making guidelines for managing inventories throughout the distribution network, striving to minimize associated costs. The trade-off in inventory management lies between ensuring adequate inventory levels to meet customer demand and service levels, which may necessitate holding a larger inventory, versus minimizing holding costs, which reduces product availability and may compromise customer satisfaction.

Inventory management is a classical topic with researchers, over the years, diving into ways to make it more efficient and cost-effective (Svoboda et al. 2021). One intriguing approach is the use of multi-echelon inventory control models. These models, showcased in various research papers, offer exciting potential for cutting down on excess inventory while still meeting customer needs. However, few of these models have made it into practical implementation (Berling et al. 2023).

Conventional multi-echelon inventory models often operate under oversimplified assumptions regarding demand distributions and network structure, limiting their practical applicability. Particularly, many of these models assume centralized control over all distribution points, neglecting scenarios where certain retailers operate independently, beyond the company's direct control. Consequently, implementing such models becomes difficult in real-world settings where control over stock levels for all retailers isn't possible. This underscores the necessity for an inventory control model that doesn't compromise on practicality.

The innovative model studied in this Master thesis breaks away from simplistic demand assumptions and accommodates distribution systems including independent dealers whose stock levels can't be dictated. Moreover, it enables the differentiation of retailers, allowing for the establishment of individualized target service levels and optimization of inventory levels across the system to satisfy all stakeholders.

The model, as illustrated in Figure 1, supports service-differentiated channels. It includes one distribution channel for controllable retailers, where inventory policies can be dictated. The other channels, catering demand from non controllable retailers, are modeled as direct demand at the central warehouse and are integrated into the central warehouse stock, with critical levels dictating the inventory policy for the reservation stock. These critical levels determine which channels' demands should be satisfied by the stock on hand. A new heuristic developed by Prof. Johan Marklund at LTH extends the work of Berling et al. (2023) and optimizes inventory levels for the distribution system including additional service-differentiated channels, minimizing stock while meeting service level targets across all retailers.

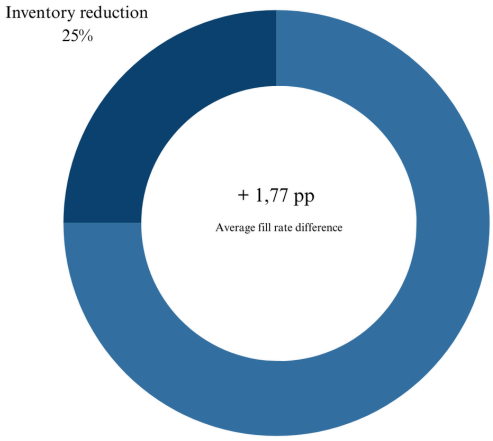

Figure 2: Result from the conducted study.

Casting the focus on Volvo, the study was conducted using authentic data sourced from their operations in the African market. The methodology employed follows the framework of an operations research study. The analytical model, developed in Python, was subsequently validated using a discrete event simulation model developed in the software Extendsim 10. All results stems from simulating Volvo's distribution system for the south African market, with inventory parameters set according to the analytical model. The study shows that the new method renders an average stock reduction by 25%, while increasing the service levels, closely aligning with the predetermined targets, see Figure 2.

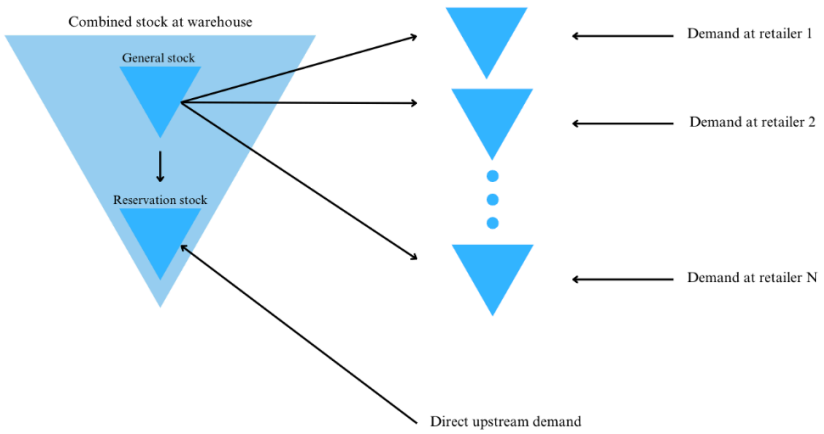

Figure 1: A representation of the investigated model.

REFERENCES

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