Department of Industrial Engineering & Innovation Sciences,
Operations, Planning, Accounting & Control (OPAC) group

EINDHOVEN UNIVERSITY OF TECHNOLOGY

Master Thesis Poster, Farah Schepens

Towards End-to-End Segmentation in Supply Chain Management

Supervisors: dr. K.H. van Donselaar, dr. C. Fecarotti, dr. ir. N.P. Dellaert

Context and Objective

A one-size-fits-all planning approach can lead to unnecessary inventory, inefficient replenishment frequencies, and suboptimal service levels when managing a diverse product portfolio. Segmentation allows planning rules to be tailored to product characteristics. However, existing studies focus on isolated domains, and an integrated, end-to-end perspective that aligns decisions across the supply chain is still missing.

This thesis is conducted in collaboration with a company, using real operational data to evaluate planning strategies across the supply chain. It assesses the need for an end-to-end segmentation approach and links demand volume and volatility to differentiated planning decisions across five areas:

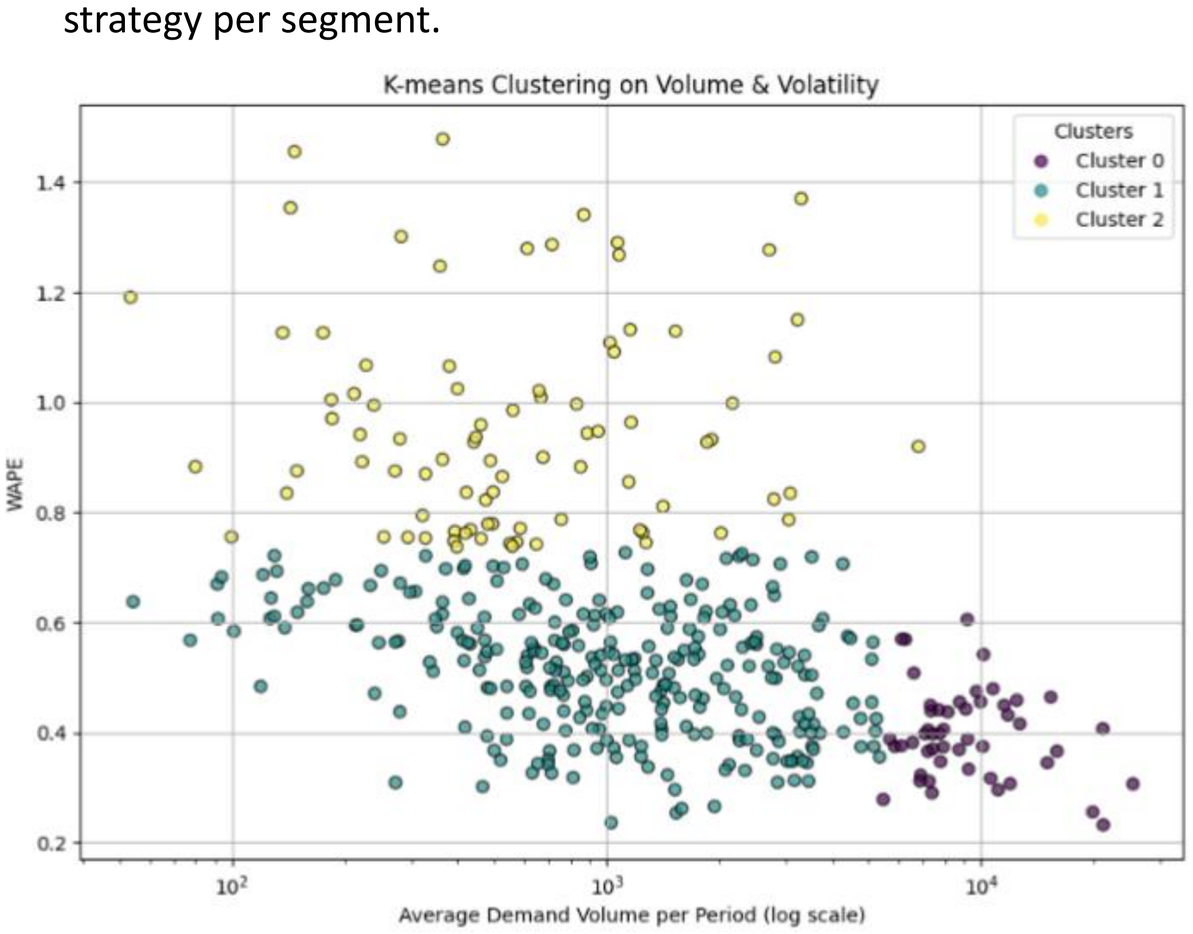
- Forecast segmentation (no-touch, low-touch, high-touch)
- Service segmentation (FG safety stock levels)
- Manufacturing segmentation (replenishment frequency)
- Inventory positioning (pack safety stock levels)
- Product prioritization (based on financial value)

Research Approach

1. Segmentation and forecasting - Products were clustered by demand volume and volatility. Each cluster was assessed with a Forecast Value Added analysis to determine the appropriate level of manual forecasting effort.

2. Simulation of operational decisions - A discrete-event simulation evaluated the impact of varying replenishment frequency, pack SS, and FG SS, first individually and then jointly.

3. Evaluation using the 3C framework - Performance was assessed using Customer Service Level, Cost, and Cash, allowing quantification of trade-offs and identification of the best strategy per segment.



Key Findings

1. Forecasting

- Manual forecast adjustments do not consistently add value.
- Forecast errors are lowest for high-volume, predictable products and increase for the more volatile clusters.
- Recommended forecasting effort per segment:
  - No-touch for high-volume, low-volatility products and for highly volatile products,
  - Light-touch for medium-volume, medium-volatility products.

2. Safety stock vs. volatility

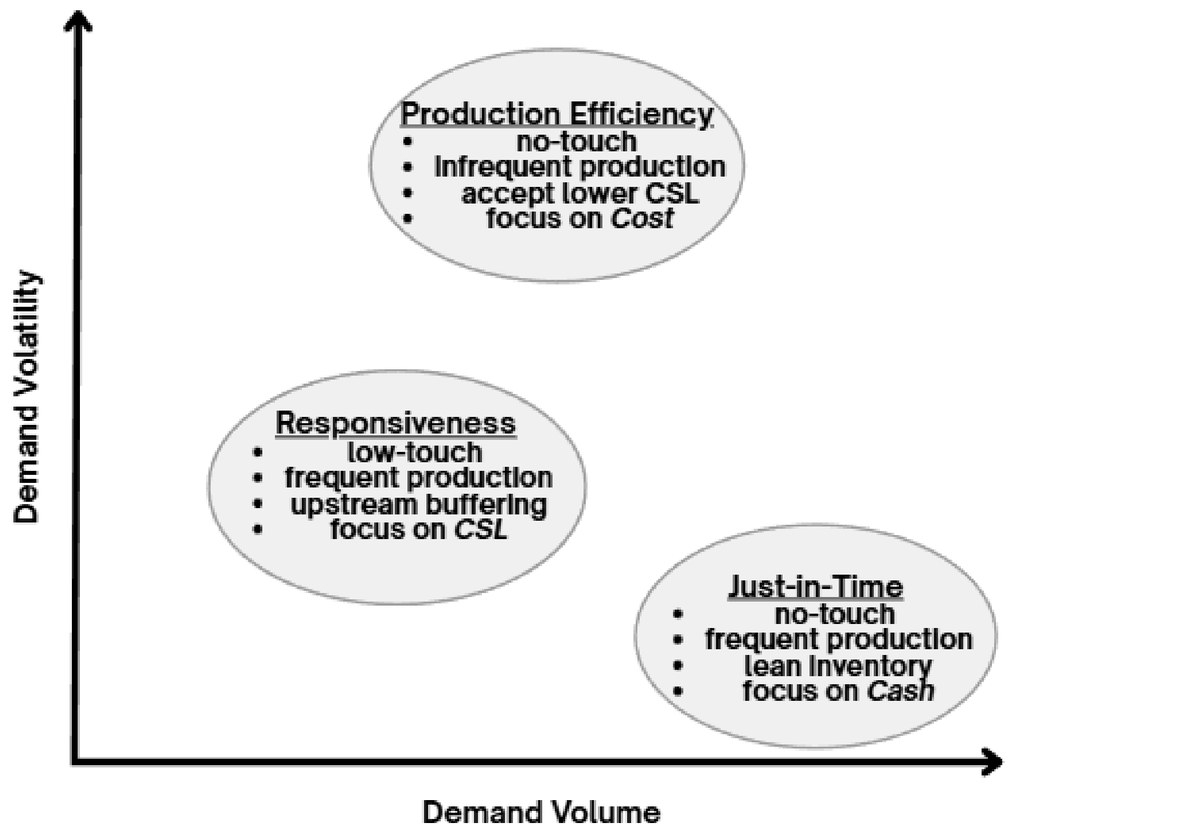
- FG safety-stock days are very similar across clusters, despite substantial differences in demand volatility.
- Aligning safety-stock days with volatility can improve performance.

3. Interdependent decision factors

- Replenishment frequency, pack safety stock and FG safety stock are strongly interdependent.
- They cannot be optimized in isolation and should be tuned jointly.

4. Dominant strategy profiles

- Just-in-Time strategy (high-volume, predictable products): frequent production, minimal FG buffers, and focus on cash efficiency.
- Responsiveness-oriented strategy (medium-volume, medium-volatility products): frequent production and upstream buffering, with a clear focus on maintaining high service levels.
- Production-efficiency strategy (highly volatile products): larger and less frequent production runs, and acceptance of lower service levels to reduce overall cost.



Conclusions

- Segmentation can be used to link demand volume and volatility to differentiated supply chain strategies.
- Jointly tuning forecast effort, replenishment frequency, FG and pack safety stock, and product prioritization per segment improves performance across Customer Service, Cost, and Cash.