

## DEKKER'S MODEL FOR Cold Chain Order Picking Heuristics

Aspect	S-Shape Heuristic	Mid-Point Heuristic	Combined Heuristic
Routing Strategy	Picker enters each aisle and exits from the opposite side (full aisle traversal).	Picker enters aisle up to the point where last item is located, then returns.	Mix of S-shape (for dense areas) and Mid-point (for sparse areas).
Best Suited Storage Area	Frozen Chamber (2000 sq. ft, 7.5 ft height) – slower movement area, use full traversal to minimize re-entry in cold conditions.	Chilled Chamber (2000 sq. ft, 8 ft height) – higher SKU volume and variability, ideal for efficient partial traversal.	Use in ante-room + crossover zones or for mixed-temp orders.
Storage Policy Coupling	Fixed slotting for heavy/multi-order frozen SKUs to minimize location confusion.	Velocity-based slotting in chilled area – fast movers near aisle entrances.	Zonal slotting – match picker zone with routing type for hybrid picking.
SKU Characteristics	Bulk frozen fish/meat blocks that need precise cold hold; fewer but heavier items.	High-variety chilled items like cheese packs, juice, milk – high pick frequency.	Orders with SKUs from both zones; requires coordination.

Order Profile Fit	Ideal for orders with items across multiple aisles or bulk frozen lines.	Ideal for shorter orders ( $\leq 3-4$ items) with high turnover SKUs.	Ideal for typical 5-line-item orders across zones.
Time & Efficiency	More time-consuming but consistent; avoids aisle redundancy.	Faster picking but risk of back-and-forth in dense SKU areas.	Balanced effort, reduces fatigue and improves load clustering.
Dry Ice Handling	Enables dry ice to be added post full-pick at the exit, minimizing exposure.	Risk of backtracking increases exposure to warm air; needs care in packing zone.	Allows dry ice to be added mid-pick based on zone logic.
Loading Coordination	Suits batch picking for route-based loading to reefer vans.	Better for discrete picking where order integrity is important.	Supports cluster picking for similar route consolidation.
Heuristic Complexity	Simple to train and implement; reliable under cold constraints.	Requires good SKU location visibility; may confuse novice pickers.	Needs smart WMS or voice-pick systems to execute well.