

Fluid-based Slotting Optimization for Automated Order Picking System with Multiple Dispenser Types

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Abstract: Slotting strategy heavily influences the throughput and operational cost of automated order picking system with multiple dispenser types, which is called the complex automated order picking system (CAOPS). Existing research either focuses on one aspect of the slotting optimization problem or only considers one part of CAOPS, such as the Low-volume Dispensers, to develop corresponding slotting strategies. In order to provide a comprehensive and systemic approach, a fluid-based slotting strategy is proposed in this paper. The configuration of CAOPS is presented with specific reference to its fast-picking and restocking subsystems. Based on extended fluid model, a nonlinear mathematical programming model is developed to determine the optimal volume allotted to each stock keeping unit (SKU) in a certain mode by minimize the restocking cost of that mode. Conclusion from the allocation model is specified for the storage modules of high-volume dispensers and low-volume dispensers. Optimal allocation of storage resources in the fast-picking area of CAOPS is then discussed with the aim of identifying the optimal space of each picking mode. The SKU assignment problem referring to the total restocking cost of CAOPS is analyzed and a greedy heuristic with low time complexity is developed according to the characteristics of CAOPS. Real life application from the tobacco industry is presented in order to exemplify the proposed slotting strategy and assess the effectiveness of the developed methodology. Entry-item-quantity (EIQ) based experiential solutions and proposed-model-based near-optimal solutions are compared. The comparison results show that the proposed strategy generates a savings of over 18% referring to the total restocking cost over one-year period. The strategy proposed in this paper, which can handle the multiple dispenser types, provides a practical quantitative slotting method for CAOPS and can help picking-system-designers make slotting decisions efficiently and effectively.

Key words: slotting, complex automated order picking system, restocking cost, dispenser

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