

Layout Optimization of Line-Feeding Kit Areas in a Manufacturing Facility: A Mixed-Integer Programming Approach

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Abstract

In lean manufacturing environments, assembly lines are continuously fed by kit carts that carry part sets directly to workstations. The physical placement of kit storage areas on the shop floor directly determines the travel distances of these carts and, consequently, the responsiveness of the supply system. Despite its operational significance, this problem has received limited attention in the optimization literature. This study addresses that gap by developing a Mixed-Integer Programming model for the kit area assignment problem, applied to a real manufacturing facility with 31 storage blocks and 12 locations serving multiple assembly lines. The model minimizes the frequency-weighted distances between storage blocks and assembly lines, while penalizing the distance between blocks when a product category is distributed across multiple storage locations. The model is solved to proven optimality using Gurobi within practical computation times, and the resulting layout demonstrates notable improvements over the previous manual assignment. The proposed approach is validated on real operational data and shown to be readily applicable in industrial planning settings.

Keywords

Kit area assignment, travel distance minimization, mixed-integer programming, facility layout, lean manufacturing · assembly line.