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Research on the Optimization of the Facility Layout of Efficient Cafeterias for Troops

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Abstract : BACKGROUND: A facility layout problem (FLP) is an NP-complete (non-deterministic polynomial) problem, which is hard to obtain an exact optimal solution. FLP has been widely studied in various limited spaces and workflows. For example, cafeterias with many types of equipment for troops cause chaotic processes when dining. OBJECTIVE: This article tried to optimize the layout of troops' cafeteria and to improve the overall efficiency of the dining process. METHODS: First, the original cafeteria layout design scheme was analyzed from an ergonomic perspective and two new design schemes were generated. Next, three facility layout models were designed, and further simulation was applied to compare the total time and density of troops between each scheme. Last, an experiment of the dining process with video observation and analysis verified the simulation results. RESULTS: In a simulation, the dining time under the second new layout is shortened by 2.25% and 1.89% ($p<0.0001$, $p=0.0001$) compared with the other two layouts, while troops-flow density and interference both greatly reduced in the two new layouts. In the experiment, process completing time and the number of interference reduced as well, which verified corresponding simulation results. CONCLUSIONS: Our two new layout schemes are tested to be optimal by a series of simulation and space experiments. In future research, similar approaches could be applied when taking layout-design algorithm calculation into consideration.

Keywords : layout optimization, dining efficiency, troops' cafeteria, anylogic simulation, field experiment
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