Propositions

attached to the thesis

Stochastic models for order picking systems

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I

In order to accurately model order picking systems it is essential to consider their inherent stochastic behavior.

(This thesis)

II

Queueing models provide a valuable tool to study order picking systems since they help designers in the initial design phase to quickly evaluate many design alternatives, to narrow down the available design space, and to optimize over this space.

(This thesis)

III

Multi-class jump-over queueing networks can accurately determine the performance of a zone picking system, taking into account congestion and blocking related to limited zone buffer sizes and conveyor merges.

(Chapter 2 and 3)

IV

To minimize the mean waiting time in a polling system it is often better to serve all incoming customers at a queue before switching to the next one. To minimize the batch sojourn-time, under high utilization it is better to often switch between queues than staying too long at a queue.

(Chapter 5)

V

E-commerce companies experiencing high order arrival rates can benefit from a milkrun picking system where new customer orders are dynamically added to fixed pick routes instead of using a traditional batch picking system.

(Chapter 6)

VI

Accurate process visualizations can help to make warehouse managers fully understand the effect of stochasticity on warehouse performance.

VII

Even though Dutch politicians predict that in the near future robots are going to replace manual labor in warehouses, it will take a longer time to replace the system designers and controllers.

VII

The words stochastic and random are synonyms, however researchers are more inclined to use "stochastic models" instead of "random models" as the former sounds more meaningful to the general public.

IX

Teaching warehouse design to supply chain students requires bringing knowledge of queueing theory into practice, since otherwise the queue of students with questions will grow such that it will start to block the hallway.

X

The butterfly effect appears in both deterministic and stochastic models of the weather. However, compared to deterministic models, its effect in stochastic models becomes apparent only for predictions that are further away in the future. This is because the measurement errors that cause the effect are initially indistinguishable from the natural stochastic variability in the system.

XI

Dy ’t hwet útpakke wol, moat earst in pak ha, dêr ’t hwet yn sit.