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Report on the doctoral dissertation of Mr. Kehinde Adekunle Adegbola entitled "A more-generalized multiple suppliers, single manufacturer inventory control model with stochastic demand, variable production rate and differing supplier delivery times"

This doctoral dissertation investigates a multiple-supplier, single-manufacturer supply-chain system operating under stochastic demand. The thesis develops mathematical models for both homogeneous and heterogeneous supplier settings and derives production, replenishment, and delivery policies aimed at minimizing long-run supply-chain costs. The analytical framework is complemented by numerical experiments, sensitivity analysis, and a discrete-event simulation model implemented in Arena, which is used to examine the effects of relaxing the synchronized-dispatch assumption adopted in the analytical model. The thesis demonstrates substantial effort in model development, numerical analysis and simulation implementation. In particular, the integration of analytical modeling with simulation-based analysis provides a broad framework for studying collaborative production and replenishment decisions. The comments presented below should be viewed as suggestions for strengthening the dissertation.

Comments

The presentation of the problem in Section 1.3.2 could be improved. In particular, Figure 1.1 is referenced before the corresponding notation and model components are introduced, making it difficult for the reader to fully interpret the structure and interactions represented in the figure. Introducing the key notation and system elements before discussing the figure or providing a more detailed explanation of the figure itself, would improve clarity.

The notation is potentially confusing, as the symbol F is used in both probabilistic and cost contexts, despite $F(\cdot)$being conventionally reserved for distribution functions. Distinct notation (e.g., $C(\cdot)$for costs) should be adopted to improve clarity and avoid ambiguity.

The assumptions presented in Section 3.2.1 provide a comprehensive description of the modeled supply chain system. However, the section exhibits a lack of conceptual separation between different components of the modeling framework.

Several statements classified as assumptions are more accurately interpreted as structural definitions, feasibility conditions, or elements of the optimization framework. For instance, Assumption 3 appears closely related to Assumption 2 and imposes a feasibility condition on production rates, while Assumptions 5 and 13–14 define structural and functional aspects of the

model. Similarly, Assumption 7 incorporates operational constraints related to delivery timing and stockout avoidance rather than describing an inherent characteristic of the system. Assumption 15, which specifies cost minimization, appears to constitute the objective of the model rather than an assumption. This conflation of assumptions with model structure and objectives reduces the conceptual transparency of the formulation. A clearer organization of the model into assumptions, constraints, decision variables, and objective functions would significantly enhance the rigor, transparency and readability of the analysis...

Several functions introduced without clearly specified arguments, which obscures the functional relationships in the model and reduces mathematical clarity.

Given that the normal approximation for cumulative demand is justified only for sufficiently large time intervals t, how does this assumption align with the operational decision process of the model, where inventory review, replenishment decisions and delivery scheduling appear to occur over relatively short time intervals? Could the validity of the approximation under such conditions be further justified?

Figure 3.1 presents the supplier inventory profile with an initial triangular accumulation and positive ending inventory, suggesting a transient startup cycle. However, the model is formulated within a long-run average-cost framework with steady-state behavior, as indicated by the equality between the long-run production rate and expected demand $E[\Lambda]$). The current figure appears difficult to reconcile with the steady-state assumptions underlying the model. A clearer distinction between transient and steady-state behavior would improve consistency in the analysis.

If T_l is bounded below and the constraints are linear, does this imply a finite upper bound on the number of deliveries m? If so, the feasibility region may be closed and bounded, allowing the existence of an optimal solution to be formally established. Could the thesis discuss this existence argument and the resulting finite search space for m?

Page 44 “The first constraint ensures that raw materials from the jth supplier arrive before previously delivered batches are fully consumed” Actually they a set of constraints, that requiring that raw material deliveries arrive before previously received batches are fully consumed effectively eliminates the possibility of stockouts. However, the model simultaneously incorporates backlogging costs, which presuppose the occurrence of shortages. This creates a conceptual inconsistency, as the constraint renders the backlogging term redundant.

Figure 3.5 presents a search-based solution procedure that appears to identify the best solution within the prescribed search region. However, the rationale for the selected search bounds and the relationship between the search domain and the feasible region of the optimization problem could be discussed more explicitly. Such discussion would help clarify whether the procedure is guaranteed to identify the global optimum of the original problem.

Given that the homogeneous supplier case can be obtained as a special case of the heterogeneous model, why was it presented separately?

The thesis reports key simulation parameters such as warm-up period, run length and number of replications and provides comparisons between analytical and simulation results showing close agreement. However, the justification for these settings is needed.

The simulation demand process appears to differ somewhat from the analytical demand assumptions (the validation is performed with an almost negligible variance).

Figure 5.5 is intended to illustrate the simulation logic for the manufacturer, but its low resolution makes it difficult to interpret. Since the corresponding logic is not clearly described in the text, this hinders the reader's ability to verify consistency with the analytical model and reduces the overall clarity of the simulation framework.

While the inclusion of the Arena simulation framework is valuable, could the presentation of the simulation logic and Arena modules be expanded and clarified further, particularly regarding their correspondence with the analytical model and optimization procedure?

Although the simulation framework is presented as a richer and more realistic representation of the supply chain dynamics, the implementation appears to remain largely driven by mean–variance demand characterization and expected-value analysis. As a result, the added value of the DES framework in capturing richer stochastic-process behavior and transient operational dynamics could be further clarified and demonstrated. The obtained results are primarily used to compare different supply-chain policies and parameter settings, analyze long-run average cost behavior, and demonstrate consistency between the Arena simulation outputs and the analytical model. While the simulation framework extends the operational implementation of the model, the analysis remains focused mainly on aggregate expected-value performance measures rather than detailed stochastic-process dynamics or transient system behavior.

Higher-resolution figures would improve interpretability and readability.

Addressing the points raised above would further enhance the clarity and overall contribution of the thesis. Overall, the dissertation demonstrates originality, methodological competence, scholarly maturity and it meets the requirements for a doctoral thesis in the social sciences in the field of management and quality studies.

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