Kitting versus line stocking in the automotive assembly industry: the influence of part characteristics

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Abstract

Kitting and line stocking are two part feeding methods that are common in industry. Each system has particular operational benefits and disadvantages but there is a lack of research investigating the trade-offs between both systems. A mathematical cost model is presented for the assignment of individual parts to the materials supply method which is most cost effective for the overall materials delivery system (kitting or line stocking). The model is tested on realistic datasets. Results are presented.

Keywords: materials handling, assembly lines, kitting, line stocking

1 Introduction

Line stocking and kitting are two alternative materials supply systems that are common in manufacturing. Line stocking systems, sometimes referred to as bulk feeding, continuous replenishment, or point-of-use storage systems, supply components to the assembly line in individual component containers. Full containers are stored close to the assembly workstations at the border of line, and a two-bin or reorder point system is used to control replenishment. Kitting systems group together various components into one package according to a future assembly schedule and supply these kits to the line. The exact quantity of components required is stored in kit containers at assembly workstations at the border of line, and replenishments are carried out according to takt times. Both kitting and line stocking systems can offer certain operational benefits. However, research that examines the factors that determine where each is best applied is quite limited. Companies lack the experience-based knowledge to guide decisions on where each type of system should be used [1].
2 Mathematical model and computational testing

A mixed integer programming model is developed to assign parts to materials supply system alternatives to minimize total costs, given the average part and production mix characteristics. This is a static and deterministic optimization problem, where the costs are the yearly labor costs for operator picking at the line, internal transport, the kit assembly operation and replenishment of the supermarket.

The mathematical model is implemented using the modeling language AMPL 11.2, and solved with CPLEX 11.2 on an Intel Centrino Duo 1.67 GHz with 2 GB RAM memory. Numerical results of a case study have indicated that kitting all parts is not a good way to answer to the shortage of space at the line. Additional datasets were created for testing. Sensitivity analyses are carried out to investigate the impact of part characteristics - such as usage rate, size and the availability of part variants - on the assignment.

3 Conclusion

The model fills a gap in the international scientific literature related to kitting, taking into account the part characteristics and practical constraints for the development of hybrid feeding policies. Testing the model with various datasets generates insight in the trade-offs between kitting and line stocking. Further research efforts will be directed towards extensions and refinements to the model.

References