

Optimizing line feeding under consideration of variable space constraints

Nico André. Schmid

Ghent University, Department of Business Informatics and Operations Management

e-mail: nico.schmid@ugent.be

Veronique Limère

Ghent University, Department of Business Informatics and Operations Management

Flanders Make, Lommel, Belgium

e-mail: veronique.limere@ugent.be

November 10, 2017

Nowadays, assembly systems are used for the assembly of a number of models, often being mass-customized, which increases the number of parts required for assembly. Due to a rise of part numbers, space scarcity at the line is a problem occurring frequently in practice. Therefore, parts must not only be fed to the line in a cost efficient manner, but space constraints need to be taken into account as well [Limere et al., 2015]. The assembly line feeding problem (ALFP) deals with the assignment of parts to line feeding policies in order to reduce costs and obtain feasible solutions [Bozer and McGinnis, 1992].

Within this paper, we examine all known distinct line feeding policies, namely line stocking, kanban, sequencing and kitting (stationary and traveling kits). There is, to the best of our knowledge, no research conducted, including more than three line feeding policies in a single model [Sali and Sahin, 2016]. However, although using different line feeding policies might solve the problem of space scarcity, it might also be an expensive solution and more cost effective alternatives might exist. Therefore, in our approach we model the available storing space at every single station of the line as a variable, while the overall space available for the complete line stays constrained [Hua and Johnson, 2010]. This way, we can investigate if space sharing between stations leads to cheaper solutions.

In our research, we model this problem as a MILP problem including a representation of costs and constraints caused by the necessary line feeding processes, being storage, preparation, transportation, line side presentation and usage. By incorporating variable space constraints for every station, we provide a decision model minimizing the overall costs for line feeding in assembly systems, since rigid space constraints at the BoL usually lead to more expensive line feeding policies. In contrast, variable space constraints enable balancing of unequal space requirements at different stations, which allows cheaper line feeding policies to be selected. The proposed model can be solved by standard solvers, such as CPLEX or Gurobi.

Furthermore, we propose a data generation algorithm using case study data being capable of creating data sets with multiple products, although in the case study one model was produced on the line. This paves the way to examine the effect of different products on space borrowing and line feeding policy selection.

Finally, we use the decision model and multiple generated data sets to run experiments and analyze the results for decision patterns for line feeding policy and space borrowing decisions. First results, such as cost effects of space borrowing or the influence of demand or part volume on line feeding policy decisions, will be shown.

References

- [Bozer and McGinnis, 1992] Bozer, Y. A. and McGinnis L. F. (1992). Kitting versus line stocking: A conceptual framework and a descriptive model. *International Journal of Production Economics*, 28(1):1–19.
- [Hua and Johnson, 2010] Hua, S. Y. and Johnson, D. J. (2010). Research issues on factors influencing the choice of kitting versus line stocking *International Journal of Production Research*, 48(3):779–800.
- [Limere et al., 2015] Limere, V., van Landeghem, H., and Goetschalckx, M. and McGinnis L. F. (2015). A decision model for kitting and line stocking with variable operator walking distances. *Assembly Automation*, 35(1):47–56.
- [Sali and Sahin, 2016] Sali, M. and Sahin E. (2016). Line feeding optimization for just in time assembly lines: An application to the automotive industry. *International Journal of Production Economics*, 174:54–67.