# A nested decomposition approach to a 3-stage 2-dimensional cutting stock problem

François Vanderbeck

MAB, Université de Bordeaux 1, 351, Cours de la Libération, F-33405 Talence Cedex, France

Fax: +33 (05) 57 96 21 23, Email: fv@math.u-bordeaux.fr, Url: http://www.math.u-bordeaux.fr/~fv

July 1999 (revised in January 2000)

**Abstract**

We consider the cutting of rectangular order pieces into stock pieces of specified width and length. The cutting process involves 3-stages of orthogonal guillotine cutting: stock pieces are cut into sections that are cut into slits that are cut into order pieces. Restrictions imposed on the cutting process make the combinatorial structure of the problem more complex but limit the scope of solution space. The objective of the problem is mainly to minimize waste, but our model also accounts for other issues such as aging stock pieces, urgent or optional orders, and fixed setup costs. Our solution approach involves a nested decomposition of the problem and the recursive use of the column generation technique: we use a column generation formulation of the problem (Gilmore and Gomory, 1965) and the cutting pattern generation subproblem is itself solved using a column generation algorithm. LP-based lower bound on the minimum cost are computed and, by rounding the LP solution, a feasible solution and associated upper bound is obtained. This approach could in principle be used in a branch-and-bound search to solve the problem to optimality. We report computational results for industrial instances. The algorithm is being used in industry as a production planning tool.

**Keywords**

Cutting Stock, Trim Loss, and Knapsack Problems; Integer Programming and Nested Decomposition.