Production and distribution operations are two most important operational functions in a typical supply chain. The optimization of these functions plays a critical role in achieving supply chain efficiency. In this chapter, we apply the celebrated column generation methodology to real-time optimization of production and distribution operations. We first provide a survey of existing results of column generation techniques applied to various static combinatorial optimization problems. We then propose a column generation based solution framework for solving dynamic production scheduling and dynamic vehicle routing problems. The approach is intended to work in a real-time environment where new jobs or customer orders may come in dynamically over time. Computational results are reported.

1. Overview of Real-Time Supply Chain Optimization Models
   - Optimization Models for Production Operations
   - Optimization of Distribution Operations
   - Other Supply Chain Operation models
   - Overview of this chapter
   -- What to do in the next 3 sections

2. A Computational Framework for Real-Time Supply Chain Optimization
   * Introduction of column generation methodology
     - Set partitioning type formulation & Dantzig-Wolfe decomposition for LP relaxation
     - Branch and price framework (master problem, subproblems, branching strategies)
   * Survey of column generation techniques applied to various areas including production and distribution.
     - Early applications to vehicle cutting stock & vehicle routing problems
     - Recent applications to a wide range of problem areas (crew scheduling, lotsizing, generalized assignment, graph coloring, network design, production scheduling, etc.)

   * A brief survey of results on real-time production scheduling
     -- Most existing solution approaches use simple dispatching rules (myopic, lack of robustness)
     -- Our goal is to develop a robust optimization based approach
   * Proposing a column generation framework for real-time production scheduling
     -- Approach details
     -- Advantages of the approach
   * Computational results
     -- Compare to theoretical lower bounds
     -- Compare to simple rule-based approaches

   * A brief survey of results on real-time vehicle routing
     -- Most existing results use local search heuristics (insertion, tabu search)
     -- Our goal is to have an optimization based approach that is global and robust
* Proposing a column generation framework for real-time vehicle routing
  -- Approach details
    -- Advantages of the approach

* Computational results
  -- Compare to theoretical lower bounds
  -- Compare to pure heuristics

5. Conclusions

* Summary of what we have done

* Discussion of further research issues