Large-scale production scheduling in the food industry

Scheduling of large-scale food processing facilities is a very difficult task, due to the complex production recipes and the large and ever-increasing product portfolio. Therefore, manually generated schedules underutilise the true potential of the facility. The goal is to develop a solution that provides near-optimal schedules for the food industry in low-computational times, and increase the productivity of the plant.

Benefits for Frinsa

• Automated decision-making procedure
• Generating schedules of high quality
• Fast re-scheduling actions and what-if analyses

Implementation

MILP model
Minimise total changeover time

Given
• Operational data, e.g. available equipment, processing rates.
• A weekly demand

Considering
• Full demand satisfaction
• Product quality
• Operating, design and logistical constraints

Determine
• Unit-specific general precedence framework employed
• Reduced-order model, sterilizers are modelled as a utility resource.

• Decomposition algorithm
  - Reduce computational time
  - Subset of orders optimised in each iteration
  - Insertion policy: Due date -> Production flexibility -> Size of order

Solution strategy
Near-optimal solutions in low CPU time

Input
Pre-processing
Batching algorithm
Solve MILP subproblem
Optimization-based decomposition

Output
Total Schedule

Results
Improved production efficiency

• Proposed mathematical framework employed on a real weekly demand.
• Scheduling problem solved in under 15 minutes.
• Generated optimal schedules have been validated by the industrial partner.

Modelling and Optimisation

FRINSA del Noroeste: One of the largest canned fish producer in Europe
Main plant characteristics:
• Four processing stages with multiple parallel units
• Mixed-batch and continuous processes
• More than 400 products processed in a weekly basis
• Large production with high granularity
• Order-driven demand
• Not clear production bottlenecks
• Efficient tailored-made solutions are required to get nearly-optimal production schedules

Computer-aided tool for optimal production scheduling

Optimised weekly schedule

Summary
• We developed an optimisation-based solution for the optimal production scheduling problem in a real food industry.

Conclusions
• Near-optimal schedules can be generated very short computational time.
• A significant reduction in changeovers is achieved.

Outlook
• A tool that facilitates production scheduling is developed, that improves the production efficiency of the plant.

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