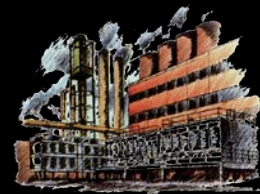




Roman Barták, Milan Jaška, Ladislav Novák, Vladimír Rovenský, Tomáš Skalický
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FLOWOPT: BRIDGING THE GAP BETWEEN OPTIMIZATION TECHNOLOGY AND MANUFACTURING PLANNERS

Motivation



- help small and medium enterprises (SMEs) to optimize their production
- Why?
 - increasing competition from low wage economies
 - existing optimization practice no more feasible
 - existing tools too expensive and too rigid
- SMEs specifics
 - connected to area of origin (no move elsewhere)
 - high variety of products (no mass production)

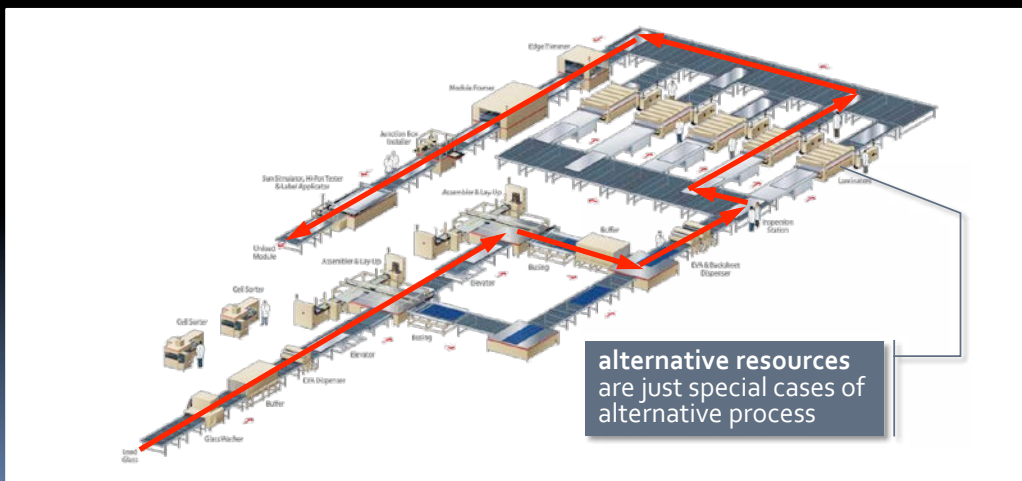
Our approach

- Be close to the customer
 - use notions that factory planners are familiar with
- Translate the problem to solving formalism
 - use flexible modelling and solving approach
- Solve the problem to acceptable quality
 - combine heuristics and inference
- Allow customers to modify the solution
 - support interactive changes of solutions

CP

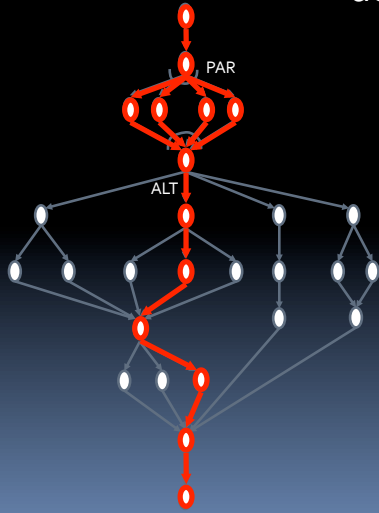
The problem

- Real-life production scheduling with alternative process routes and earliness/tardiness cost.
- Involves planning (selection among alternative processes) and scheduling (time and resource allocation).

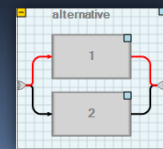
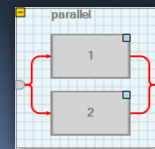
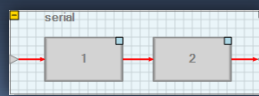


Background

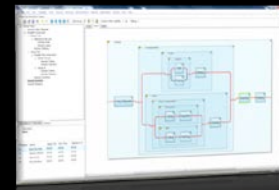
- **Workflow** is a description of manufacturing process (how to produce a given item)



- activities and relations between the activities
- we use DAG to represent workflows
 - nodes – activities
 - arcs – precedence constraints
- specific nested structure with alternative branches

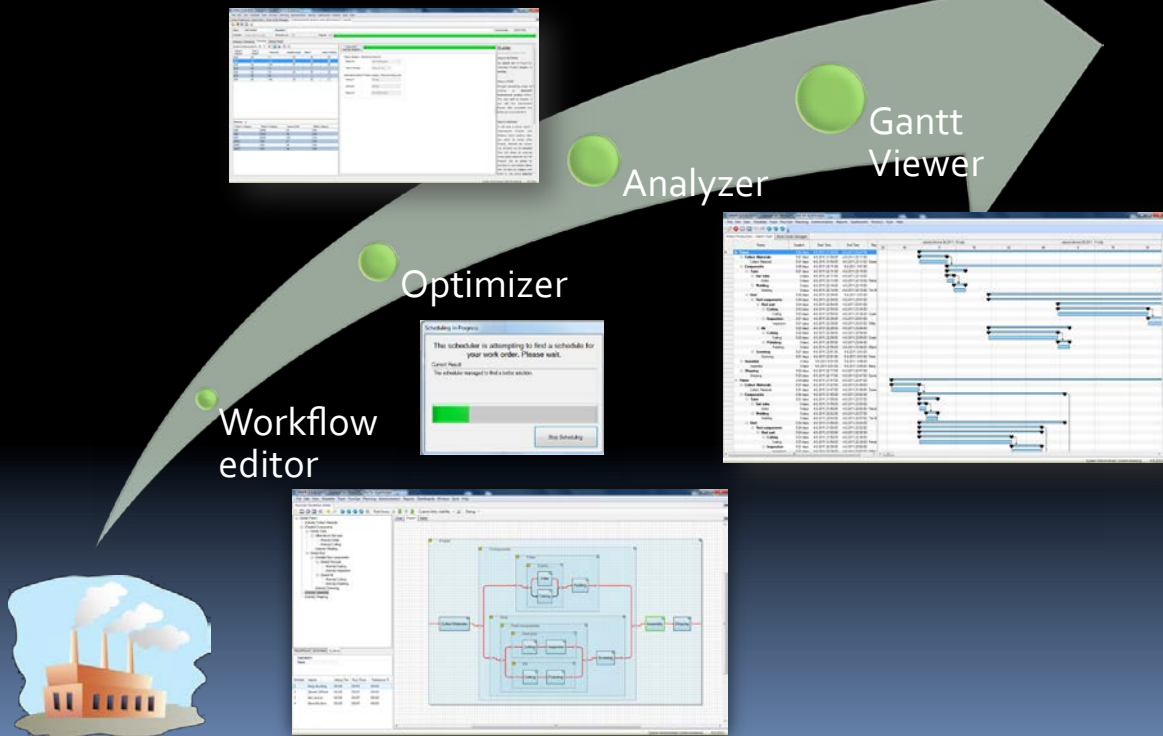


FlowOpt system



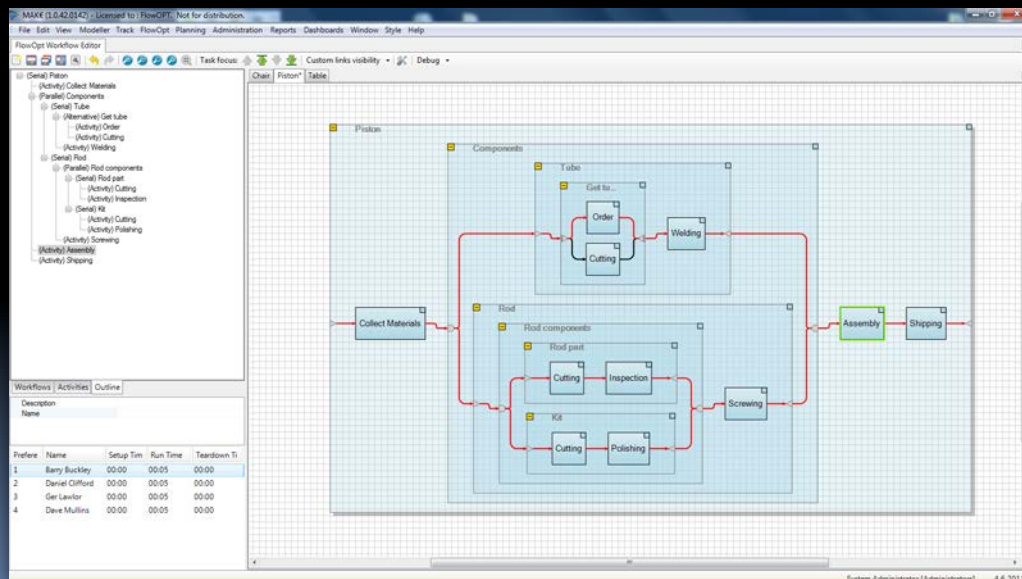
- **FlowOpt** tools build on top of enterprise optimisation system MAK€ for SMEs
 - build-to-order (engineer-to-order) production
 - on-time-in-full objective (earliness/tardiness)
- The system supports the following tasks:
 - interactive graphical design of workflows
 - creating and scheduling custom orders
 - visualisation and modification of schedules
 - schedule analysis

FlowOpt design process



Workflow editor

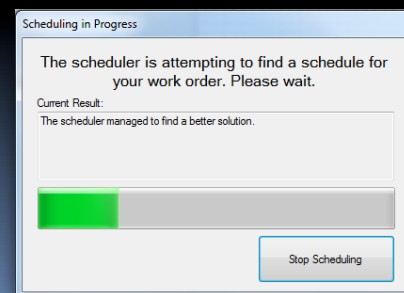
- top-down and bottom up approach to design **nested workflows**
- supports **extra logical** (mutual exclusion,...) and **temporal** (synchronization,...) **constraints**



Optimiser

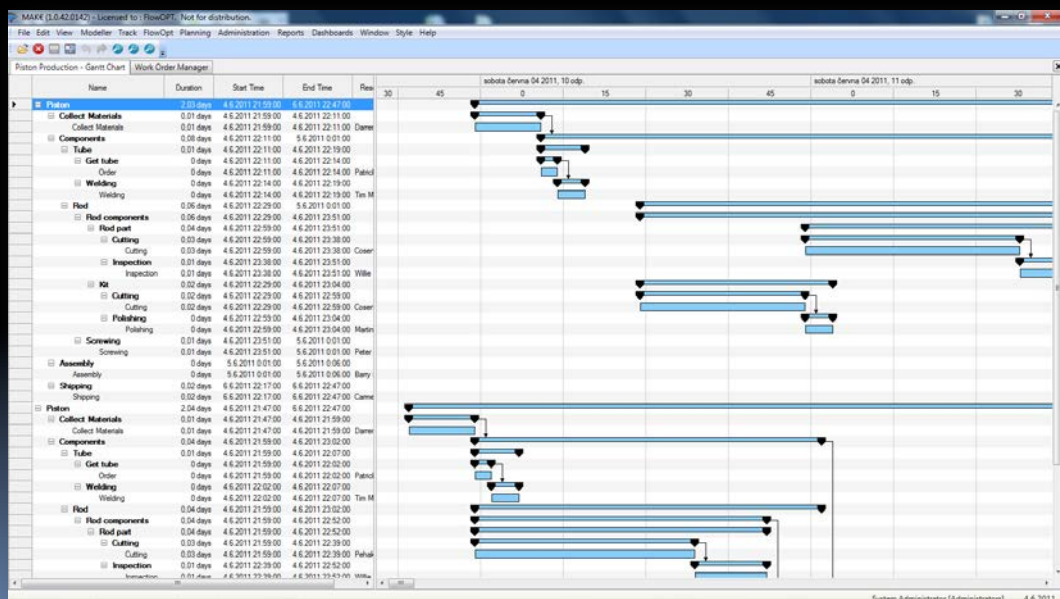
a fully automated scheduler that takes description of workflows for ordered products and generates a schedule

- implemented in ILOG CP Optimiser (OPL Studio)
- branch-and-bound optimisation (earliness and lateness costs and cost for alternatives are assumed)



Gantt Viewer

- visualization and modification of schedules



Analyser

- analysis of problems in schedules (late deliveries) and suggestions for enterprise improvements (buying a new resource)

The screenshot displays the FlowOpt software interface. The main window is titled 'Analyser' and shows a table of improvement projects. The table has columns for 'Project category', 'Cost of project', 'Real profit', 'Feasible project', 'Select*', and 'Used in Portfolio'. Below this, there is a 'Patterns' table with columns for 'Project 1 category', 'Project 2 category', 'Support profit', and 'Pattern category'. On the right side, the 'EVALUATE' panel is visible, showing a 'Project category' dropdown set to 'Add/remove resource', a 'Resource' dropdown set to 'New Resource', and a 'Type of change' dropdown set to 'Add new one'. A 'Guide' panel on the far right provides instructions for the 'EVALUATE' phase, including steps for 'SETTINGS', 'START', and 'MANAGE'.



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