

# Constraint Model to deal with Process Alternatives

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## Abstract

This document describes the constraints needed to deal with a generalized scheduling model that allows for alternative processes, bill of materials, intermediate products, and process step choices.

## 1 Model

### 1.1 Variables

The model is expressed with task variables, which represent the stature of a task starting at a time point, running until its end, with a variable duration. The task may or may not be present in the solution. We add a preference field which tells us what is our preference if that task is present in the solution.

$z_k$  task variable for order  $k$

$y_{jk}$  task variable for job  $j$  of order  $k$

$x_{ij}$  task variable for task  $i$  of job  $j$

$v_{im}$  task variable for machineTask of task  $i$  on machine  $m$

All task variables have fields

**start** start of task

**end** end of task

**duration** duration of task

**present** boolean flag that indicates if the task is present in schedule

**preference** integer preference value to use in the objective

### 1.2 Constraints

$$z_k.\text{end} \leq \text{due}_k \tag{1}$$

$$z_k.\text{start} \geq \text{release}_k \tag{2}$$

$$\text{endBeforeStart}(t_{i_1,j}, t_{i_2,j}) \quad (3)$$

$$\text{alternative}(z_k, [y_{j,k} | \text{job } j \text{ is based on an alternative process for the manufactured product of order } k]) \quad (4)$$

$$\text{span}(y_{jk}, [t_{ij} | \text{task } i \text{ belongs to job } j]) \quad (5)$$

$$\text{alternative}(t_{i,j}, [t'_{i'j} | t' \text{ is a choice for alternative task } i]) \quad (6)$$

### 1.3 Objective

$$\min \sum y_{jk} \cdot \text{pref} * y_{jk} \cdot \text{present} + \sum x_{ij} \cdot \text{pref} * x_{ij} \cdot \text{present} + \sum v_{im} \cdot \text{pref} * v_{im} \cdot \text{present} \quad (7)$$