

# Optimal Periodic Scheduling of Continuous Multiproduct Plants

*Pedro M. Castro & Augusto Q. Novais. Departamento de Modelação e Simulação de Processos, Instituto Nacional de Engenharia Tecnologia e Inovação, 1649-038 Lisboa, Portugal. Emails: pedro.castro@ineti.pt; augusto.novais@ineti.pt*

## Problem Statement

Consider the periodic scheduling problem of multistage, multiproduct continuous plants. Periodic scheduling is favored wherever there are stable product demands over extended periods of time. Given are a set of products  $i \in I$  that must follow a sequence of processing stages  $k \in K$ , to reach the condition of final products; a set of available equipment units  $m \in M$ , each allocated to a single stage, with set  $M_k$  including the units belonging to stage  $k$ . The plant features intermediate storage tanks for each product and stage of production (Figure 1).

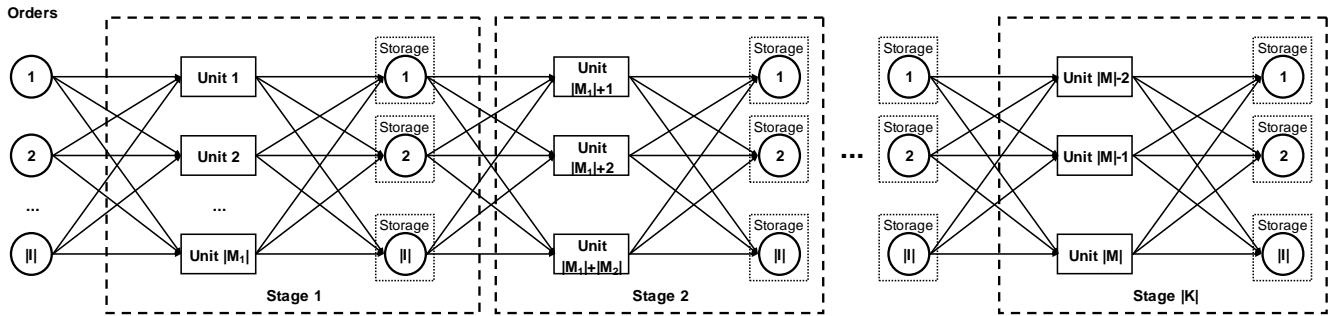


Figure 1. Multiproduct continuous plant with parallel equipment units and dedicated intermediate storage units.

The continuous processing tasks are characterized by maximum processing rates  $\rho_{i,m}^{max}$  (kg/h). These will normally be met even though it is possible to operate at lower rates. Transition times arise between the processing of two successive products in the same unit and are sequence dependent,  $cl_{i,i',m}$  (h). The price of the final products, which are subject to a minimum demand rate  $d_i$  (kg/h), are given by  $c_i$  (\$/kg). Intermediate storage costs  $ci_{i,k}$  (\$/kg) are directly related to the capacity of the corresponding storage tank. Final storage costs are dependent both on the amount stored and the storage time (\$/kg/h) and are given by  $cf_i$ . Finally, transition costs are represented by  $ct_{k,i,i'}$  (\$/h).

The objective will be to find a cyclic schedule that maximizes the profit. The tradeoff involved is that as the cycle time increases, there will be fewer changeovers on a fixed time basis (e.g. a year) but storage vessels of larger capacity will be required. More specifically, the problem consists in determining the: i) cycle time; ii) assignment of orders to equipment units; iii) sequence of orders allocated to the same equipment unit; iv) length of processing and cleaning tasks; v) processing rate of continuous tasks; vi) amounts of products to be produced; vii) levels of intermediate storage and final product inventories.