HI-010

Computational Models and Algorithms for Enterprise-wide Optimization of Process Industries (EWO)

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Abstract

The process industry is a key industrial sector in the U.S. and in the state of Pennsylvania. For instance, the chemical industry is the major producer in the world (26% of world production) with shipments reaching $454 billion (2% of the total U.S. GDP, 12% of the manufacturing GDP) and a record $80.2 billion in exports in 2001. Enterprise-wide optimization (EWO) has become a major goal in the process industries due to the increasing pressure for remaining competitive in the global marketplace. EWO involves simultaneously optimizing the operations of supply, manufacturing and distribution activities of a company to reduce costs and inventories. A major focus in EWO is the scheduling of manufacturing facilities, as well as their modeling at the proper level of detail, often requiring nonlinear process models. Major operational items include planning, scheduling, real-time optimization and inventory control. One of the key features in EWO is integration of the information and decision-making among the various functions that comprise the supply chain of the company. This is being achieved with modern IT tools, which together with the Internet has promoted e-commerce. However, to fully realize the potential of transactional IT tools, the development of sophisticated deterministic and stochastic linear/nonlinear optimization models and algorithms (analytical IT tools) is needed to explore and analyze alternatives of the supply chain to yield overall optimum economic performance, as well as high level of customer satisfaction. An additional challenge is the integrated and coordinated decision-making across the various functions in a company (purchasing, manufacturing, distribution, sales), across various geographically distributed organizations (vendors, facilities and markets), and across various levels of decision-making (strategic, tactical and operational).