OVERVIEW OF METHODOLOGIES FOR PROCESS OPERATIONS

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Manufacturing in the process industries has faced tremendous changes in recent years. We have seen a transition from a supply driven to a demand driven market. The delivery of the right product at the right time and location at the right price is a key to achieve customer satisfaction. The increasingly competitive market together with tightening regulations have resulted in increasing pressure on manufacturing and process operations. Despite the decreasing profit margins, plants have to be operated safely with decreasing environmental impact in a flexible and agile manner. Due to largely saturated markets new plants are rarely built but existing assets have to be utilized to the extent possible with only limited opportunities for plant upgrades. Competition is still increasing due to the global availability of information on price and quality of raw materials, utilities and products due to internet technologies.

The changing business environment asks for new strategies in plant operation. Rather than aiming at steady-state operation of continuous processes and long campaigns of batch processes, the plants have to be operated in a highly transient mode to exploit the dynamics of the market and the supply chains the plant is part of. Rather than understanding these dynamics as disturbances to plant operations, they should be considered as potentials to be exploited. Therefore, plants have to operate in a *supply-chain conscious intentionally dynamic mode* [1]. Given the tremendous complexity, such an objective can only be satisfactorily achieved, if more advanced model-based methodologies will be developed and implemented.

Model-based methodologies for process operations can build on various forms of a-priori knowledge to support the functions in the hierarchical layers of an integrated operations management system. Such knowledge includes the experience of plant operators, historical plant data, all kinds of qualitative as well as quantitative models differing in rigor and detail they capture. Besides an increasing use of model-based solutions, vertical integration across the hierarchical layers of the operations management systems and horizontal integration across the supply chain have to be exploited to the full extent. Additionally, process and supply chain management have to be linked with corporate decision making via existing enterprise resource planning systems.

It is virtually impossible to address all the current and future methodological needs to better support and manage process operations in a single session. Instead, recent developments and future trends are discussed in three exemplary key areas. *Barton and Lee* deal with the fundamental problem of dynamic optimization of hybrid systems with continuous-discrete dynamics. Reliable and robust optimization algorithms which can be applied in real-time to large plant models have to be considered as enablers to implement model-based process management systems in the longer run. The paper discusses recent progress in the area. Much work has still to be done to apply such optimization algorithms to the design of process operations. *Bagajewicz* addresses in his contribution the design of sensor networks. Obviously, the quality and availability of measurement information is determining the possible benefits from any kind of operation support to a large extent. Despite such relevance, the proper design of the sensor network covering sensor location as well as measurement quality has not yet gained sufficient attention. Only few results have already been introduced in industrial practice beyond steady state data reconciliation. *Venkatasubramanian* addresses issues in the area of supervisory control. The relevance of supervisory control is expected to increase with the increasing complexity of operation management systems. Supervisory control techniques form the link between operators and partially automated operations management systems. The contribution focuses on the identification and diagnosis of faults as well as on process hazards analysis.

[1] Backx, T., O. Bosgra, W. Marquardt: Towards supply-chain conscious intentionally dynamic operation of process plants. FOCAPO'98. Paper available at www.lfpt.rwth-aachen.de/publications/Techreport/1998/LPT-1998-25.