240j Production Planning and Scheduling Practices in the Pharmaceutical and Specialty Chemical Industries

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This presentation will review the state of the art in production planning and scheduling tools and their applications in the pharmaceutical and specialty chemical industries. Particular emphasis will be placed on issues of cycle time reduction and debottlenecking of multi-product facilities. A systematic methodology will be presented for identifying and eliminating size, time, and throughput bottlenecks that limit production in single and multi-product facilities. The methodology will be illustrated with two industrial case studies. The first case study deals with the optimization of a multi-product facility that produces therapeutic monoclonal antibodies (MABs). MAB processes are characterized by a long bio-reaction time (e.g., 2-3 weeks for batch operation or 2-3 months for perfusion operation). The cycle time for processing a lot in the recovery and purification train usually takes 2-3 days. Consequently, one way of increasing throughput is by installing extra bioreactors that operate in staggered mode and utilize the same recovery train. The result is that multiple batches may be at different stages of completion at any given time. Since equipment for cleaning (e.g., CIP skids) and buffer preparation is shared by multiple steps across many batches, this type of operation leads to time/scheduling bottlenecks that constrain the cycle time and the throughput of the processes. The problem becomes much more challenging in the context of a multi-product facility and when constraints imposed by limited availability of resources are considered. Resources include demand for various types of labor, utilities, and raw materials. Our methodology and its computer implementation will illustrate how to systematically identify and eliminate such bottlenecks. The second example deals with technology transfer and optimization of manufacturing of active pharmaceutical ingredients (APIs). Manufacturing of APIs is characterized by extensive reuse of equipment and campaigned production of intermediates. The intermediates are typically stable compounds stored in power or crystal form. The various intermediates are produced in the same or different facilities. A typical challenge that manufacturers face is what to produce where and when. This requires knowledge of the dynamic capacity of each plant for each product. If no adequate in-house capacity is available, a manufacturer must be able to interact in a timely fashion with outside providers (contract manufacturers). The methodology we have developed to address such problems along with its computer implementation will be presented in detail.