



## Bioprocess Systems Engineering Applications in Pharmaceutical Manufacturing

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### Message from the Guest Editors

Biopharmaceutical and pharmaceutical manufacturing are shifting to a modernized mode, built on the application of computer-based methods of process systems engineering. This development is also supported by the process analytical technology initiative (PAT) and quality by design (QbD) methodology for enhancing the understanding of integrated processes. The major goals of this effort can be summarized into developing a mechanistic understanding of a wide range of process steps, including the development of technologies to perform online measurements and real-time control and optimization. Furthermore, minimization of the number of empirical experiments and the model-assisted exploration of the process design space are targeted. Even if tremendous progress has been achieved so far, there is still work to be done in order to realize the full potential of the process systems engineering toolbox.





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