Current process control and optimization strategies are typically divided into major sections: base layer controls, advanced controls, planning & scheduling, and design. Each of these levels works at a different time scale, ranging from seconds for base controls to months at the planning and scheduling level or only once for design. The layers are segregated and this lack of information creates lost opportunities. For example, the design may be difficult to control or the base controls may ignore the process economics. Recent work shows a significant leap forward with a complete integration of all process control and optimization levels from project scheduling to base controls. Integrated control and optimization is a future direction due to the benefits of the increase of available information to optimizers. This work paves the way to fully utilize the cyber-aspects of information availability.

Several questions remain such as: (1) Is it viable to combine first principles models of a manufacturing process with large-scale planning and scheduling optimization? (2) What are the potential benefits to semi-continuous and batch manufacturing areas such as semi-conductors, pharmaceuticals, and polymers? (3) Can the latest advances in cloud computing, sensor technology, and communication devices be utilized to create a virtual distributed control system? (4) Can risks due to cyber-attack be identified and reduced? An analysis of how the layers are incorporated and the challenges and benefits are considered for a tank reactor benchmark and High Altitude Long Endurance (HALE) unmanned aircraft.