The growing adoption of Industry 4.0 and its related technologies (e.g., advanced embedded sensing, industrial internet-of-things, cyber-physical systems, big data analytics, and cloud computing) is promising a paradigm shift in the manufacturing industry. Such technologies offer opportunities to realize the goal of smart manufacturing systems. Achieving this goal, however, will require overcoming challenges, such as data heterogeneity, high dimensionality of data, and security of modern manufacturing systems. To tackle these challenges, my research approach integrates process-physics, advanced statistical knowledge, and manufacturing hands-on capabilities to effectively extract new and actionable knowledge from manufacturing data. This talk introduces some of my current research efforts to demonstrate the effectiveness of this approach. The presentation will be concluded with my future research plans and opportunities for collaborations.