Traditional mass production of standardized goods has been the source of the nation’s economic strength and leadership position in the last century. However, it is also because of mass production that we are losing the competitiveness as it cannot handle the ever changing turbulent market environment. Innovative practitioners begin to find their way to a new paradigm, mass customization, by creating variety and customization through flexibility and quick responsibility to meet customers’ diverse and changing needs. However, customized product is very challenging to be mass-produced in traditional ways, the business has to wait for today’s advanced technologies to enable profitable customization. As an emerging and advanced technology, additive manufacturing (3D printing) can fabricate parts directly from 3-dimensional digital models without part-specific tooling and fixtures. Thus, it provides tremendous flexibility and huge potential to enable mass customization and push the current marketplace to the new frontier in business competition. However, additive manufacturing is still in its infancy, multiple barriers still exist which hinders the full realization of mass customization. This talk will highlight current challenges and potential solutions for achieving mass customization by 3D printing. Process planning, geometric modeling and design optimization related to this topic will be discussed.