

Blue Sky Competition

Title: Global Distributed Manufacturing of Personalized Products as a Service

Albert Shih, Mechanical Engineering, University of Michigan

Transformative advancements in manufacturing processes (additive, machining, forming, molding, etc.) and manufacturing systems (cyber-physical, Industry 4.0, Internet of Things, artificial intelligence, global logistics and supply chain, etc.) have enabled the creation of a *global network of distributed manufacturing of personalized products as a service for people and society*. This giant leap starts from a small step in our on-going research at the University of Michigan (U-M) Orthotics and Prosthetics Center (OPC). Our research leads an evolution of ideas to envision a new paradigm of the future of manufacturing which will be intrinsically connected to everyone's daily living.

1. Local Level. U-M OPC: For over 100 years, the U-M Hospital maintains a manufacturing facility in OPC for quick fabrication of personalized assistive devices to support a major trauma center, which treats a large volume of trauma patients. In the past 10 years, a major research effort has been carried out to transform the current plaster molding based manufacturing to the cyber-based design and additive manufacturing for custom orthoses and prostheses (O&P). An additive manufacturing (AM) machine has been installed at OPC. Our goal is to demonstrate: 1) the feasibility of One-Day Visit for users to complete the measurement, design, fabrication, and evaluation of personalized ankle foot orthoses (AFO) within a single visit to the clinic and 2) the efficacy of personalized O&P made by AM and profitability of the O&P shop operation using AM for fabrication. We are working diligently to reach these goals and to build the foundation for future changes in manufacturing.

Stage 2. US National Level. Veteran Affairs (VA) National 3D Printing Network: The Veterans Health Administration is the largest integrated health care system in the US, providing care at 1,240 health care facilities, including 170 VA Medical Centers and 1,061 outpatient sites of care to over 9 million enrolled veterans. Many veterans need the O&P service. The Veterans Affairs Center for Innovation (VACI) is connecting VA hospitals across the US to form a National 3D Printing Network (see the figure of current sites on the right). We envision that AM of personalized O&P can be implemented in all 170 VA Medical Centers and most outpatient sites across the US. Veterans who need O&P care will have access to any of these distributed manufacturing sites for examination and procurement of their custom fit assistive devices made by AM within the same day of the visit.



Stage 3. Global Level. Manufacturing as a Service (MaaS) for Personalized Products. We envision that the integrated manufacturing processes (both additive and subtractive) and systems (cyber-based design software and shared data center and analytics) can enable a new business and service paradigm to manufacture personalized products meeting a wide variety of individual needs across healthcare (O&P, assistive and protective devices), leisure, work, sports, and others. We also envision that US military hospitals and service depots worldwide can adopt this global distributed manufacturing paradigm to fabricate personal devices for soldiers. This change can transform our society and make an impact on people's lives, particularly those with disabilities.