



Seminar Series

Strategic Adoption Decision of Additive Manufacturing for Low-Volume Demand



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Date: 5 November 2019 (Tuesday)

Time: 10:30 am - 11:30 am

Venue: P7303, Yeung Kin Man Academic Building (YEUNG), City University of Hong Kong

Abstract

Considering the proliferation of the additive manufacturing (AM) technology, we study the economic feasibility of adopting AM for low-volume stochastic demand products in single-facility operating enterprises. Industrial level AM machines are quite expensive causing small and medium enterprises to contemplate about its adoption. A numerical analysis aiding enterprises to decide on the magnitude of optimal AM investment has not yet found its place in the literature. Although some studies answered which products are economically better to occupy the AM capacity, they lacked some key aspects of AM, e.g., long production lead times. We use the procurement lead time of a product as a cost driver and create cost functions to estimate the long-term average costs of using AM and conventional manufacturing (CM) with stocking. Since AM technology has a limited capacity to build all products, we select the most economically suitable ones and determine the optimal number of AM machines to be invested in. For modeling purposes, we use M/G/k queueing theory due to the shared capacity in AM use and (S-1, S) inventory policy with backorders for the conventional stocking because of the low and stochastic features of the demand. In this light, we create a mixed integer non-linear program and present three solution algorithms one of which promises the global optimum. These algorithms contribute to the literature by introducing solution approaches to similar problems involving queueing coupled integer programming. Managerial implications: To aid enterprises with strategic-decision of AM adoption, our study answers: 1) Should we adopt AM for low-volume demand? 2) How many AM machines would be optimal? 3) Which products are suitable for AM? To provide a useful guide for practitioners, a detailed analysis is presented while distinguishing the focus areas of AM end-users and original equipment manufacturers. Conclusively, several extension opportunities were shared to shed light on the path of other researchers.

About the Speaker

Dr. Mingzhou Jin is a Professor and Associate Head of the Department of Industrial and Systems Engineering and Director of the Institute for a Secure and Sustainable Environment at the University of Tennessee, Knoxville (UTK). He is also directing the Logistics, Transportation, and Supply Chain Engineering (LTS) lab, the Business and Engineering for Additive Manufacturing (BEAM) Center, and the Reliability and Maintainability Engineering (RME) program for the Tickle College of Engineering. Dr. Jin has done more than 50 funded projects in the areas of transportation, logistics and supply chain management, optimization, data analytics and advanced manufacturing with funding of more than \$7M from federal and state agencies and industry, including NSF, US Department of Transportation (DOT), US Department of Energy, US Department of Homeland Security, three state DOTs, and two University Transportation Centers. He has conducted multiple projects for major companies such as FedEx, Nissan, Lockheed Martin, and Boeing, and foundations such as Material Handling Industry. He has been actively involved in IISE, being the president of the Logistics and Supply Chain division of IISE in 2016, the president of the Engineering Economy division in 2015, and currently a regional VP. He now serves as the associate editor for the Journal of Cleaner Production and is on the editorial boards of the Engineering Economists and the International Journal of Production Economics. Dr. Jin is an IISE fellow.

All are Welcome!