ASSESSMENT METHOD FOR ADDITIVE MANUFACTURING IN THE ARCHITECTURE ENGINEERING CONSTRUCTION INDUSTRY

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Buildings made of additively manufactured (AM) components are likely to have higher energy efficiency and environmental sustainability than conventionally manufactured (CM) buildings. AM building components can be highly customizable and produced with less material. Given the continued development of AM and CM technologies, many markets and the use scenarios of buildings that prioritize different performance criteria, building components will likely be produced with a mix of AM and CM technologies for the foreseeable future. However, since building professionals are not informed about the value of AM through transparent metrics like cost and environmental impact they are unable to make well-informed decisions about the application of AM in the building sector. Case studies of two AM metallic building components, a large window frame and a bracket, carried out by the authors in collaboration with a global building façade contractor demonstrated that AM for building components is technologically feasible and can lower environmental impact by up to 87%, but is cost-prohibitive today; in some cases, the manufacturing cost and schedule were about 90% higher and 91% longer respectively. Based on the case studies, a 19 step assessment method was developed with the aim to allow building professionals to rapidly and consistently assess the applicability (A), schedule (S), environmental impact (E), and cost (C) of producing building components with AM vs. CM. The formal, partially automated application of the method showed that it reduces the effort required for the ASEC analyses by 97% and improves the consistency of the A, S, and C analyses. However, it did not improve the consistency of the environmental impact (E) analysis due to the inherent flexibility of the life cycle assessment (LCA) method standardized by ISO14040. Future work includes fuller automation of the method and extension of this approach to other industry sectors.

Biography

Natasa Mrazovic, M Arch Eng, MCE, completed her PhD at the Civil and Environmental Engineering Department (CEE), Stanford University with a focus on Sustainable Design and Construction, specifically the implementation of additive manufacturing technologies popularly known as 3D printing, into the Architecture-Engineering-Construction industry. The title of her thesis is Assessment Framework for Additive Manufacturing Technologies in the AEC Industry. During her PhD studies at Stanford, she was a Research Assistant at the Center for Integrated Facility Engineering (CIFE) at CEE, Stanford University, an affiliate in the Simulation Research Group in the Environmental Energy Technologies Division (EETD) at Lawrence Berkeley National Laboratory (LBNL), US and a Visiting Doctoral Researcher at the Additive Manufacturing and 3D Printing Research Group, University of Nottingham, UK. In her 10-year long professional career as an Architect, Chief Designer, and Project Manager, she worked on large-scale projects in Eastern Europe and managed her own architectural office.

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Figure 1: Observed problem: building professionals are unable to make well-informed decisions about the application of AM in their projects, because they are not informed about the value of AM through transparent metrics like cost and environmental impac
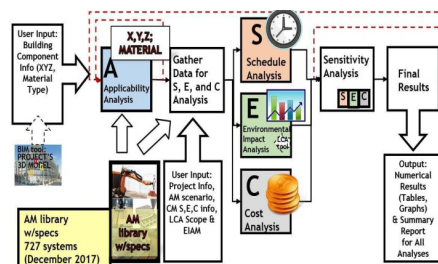
Figure 2: High-level concept diagram of the workflow of the assessment method.