

54th CIRP Conference on Manufacturing Systems

# Integration of cyber-physical HVAC systems in Incremental Manufacturing to improve Energy Efficiency and Air Quality

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## Abstract

Heating, ventilation and air conditioning (HVAC) systems in a production environment ensure safe and comfortable environmental conditions and require a significant amount of final energy in the industry. In this paper a complete cyber-physical HVAC system is presented, which is implemented in an incremental production environment to ensure these conditions. Incremental manufacturing is a concept for a flexible production system that combines additive manufacturing, subtractive manufacturing processes and other production technologies. With the cyber-physical HVAC system, energy efficiency, air quality and thermal conditions can be improved in the incremental production environment, by providing decision support, greater transparency and enabling model-predictive control in real time.

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Peer-review under the responsibility of the scientific committee of the 54th CIRP Conference on Manufacturing System.

## Keywords:

Cyber physical HVAC systems; physical simulation model; energy transparency; energy efficiency; air quality