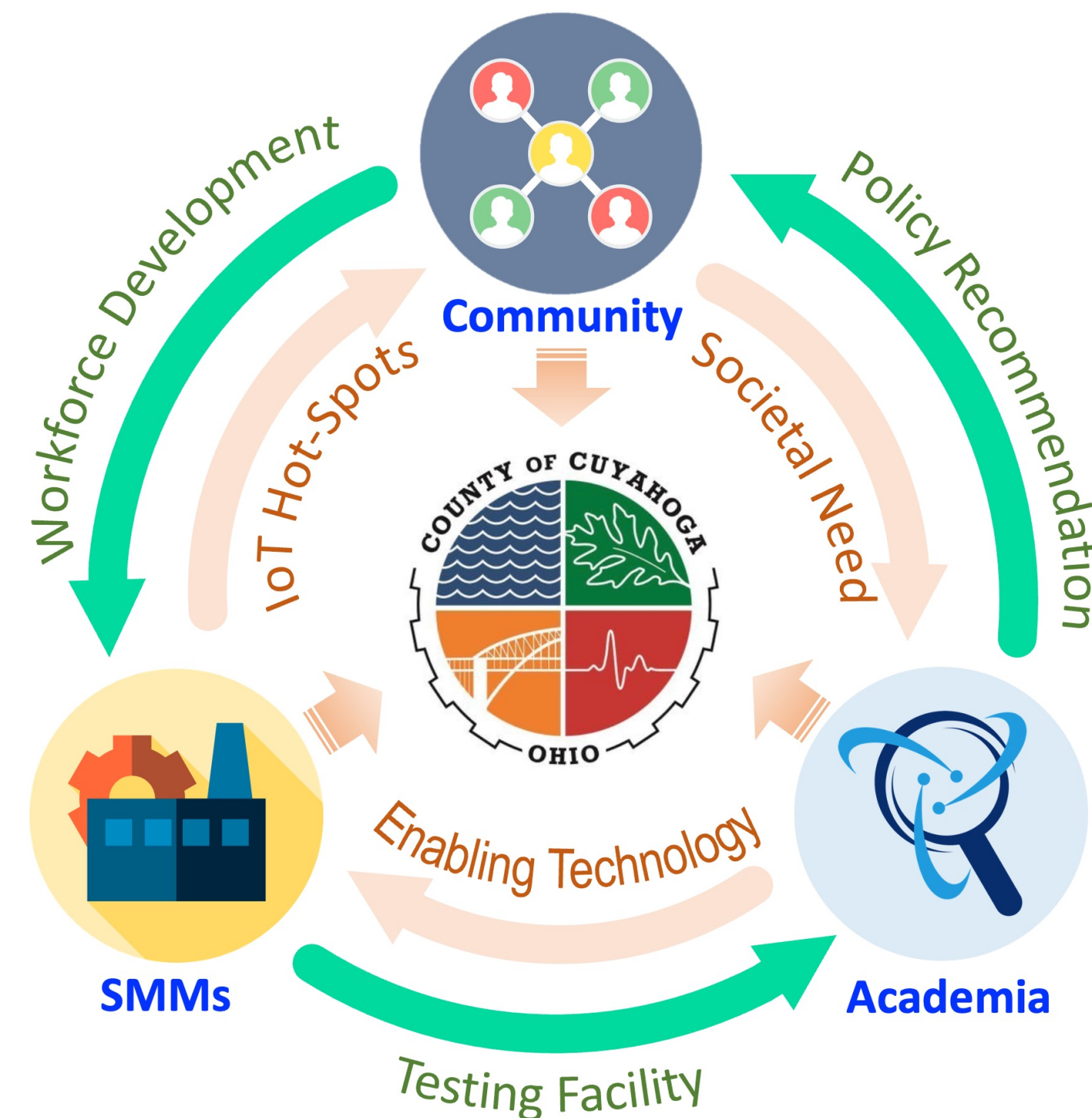


A Manufacturing-Driven Approach to Advancing Community in Northeast Ohio

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Project Objectives

This project represents a collaborative, manufacturing-driven effort among academic researchers in engineering, education, and management, community advocates and Small-to-Mid-sized-Manufacturers (SMMs) to create a smart and connected community in Northeast Ohio. Through use-inspired research on process-embedded sensing, artificial intelligence (AI), and industrial internet of things (IIoT), customized learning and collaborative platform will be created to facilitate digital transformation of workforce from experience-based operation to data-guided optimization.



Intellectual Merit

- Developing an integrated real-time monitoring system for SMM asset tracking with edge computing to improve shop floor production observability and reduce unexpected down time;
- Designing a collaborative infrastructure that stimulates and optimizes resource sharing, for cross-SMM collaboration to improve resiliency and agility facing production and supply chain variation;
- Conducting socio-technical systems modeling to prepare SMM for organizational and workforce transformation to IIoT-driven environment.

Broader Impact

- Bring science and engineering to an economically and racially diverse community in Northeast Ohio, serving as a model for neighborhoods where manufacturing takes a leadership role;
- Lead to new ways of engagement and interaction among academia, community, and manufacturers to promote research on fundamental and practical problems that ultimately benefit education, workforce development, and economic advancement.

Project Update

Use-Inspired Research:

- Developed a data acquisition and analytics system that monitors bearing condition at roll stands:
 - ✓ dynamically tracks changes in bearing health through signal processing and alerts when significant changes occur;
 - ✓ tested at Rafter Equip., a local SMM.
- Developed privacy-preserving, collaboration algorithm based on Federated Learning, evaluated using bearing diagnosis as case study:
 - ✓ achieved diagnosis accuracy of >96%, outperformed individual models obtained using data from individual user by 58%;
 - ✓ serving as basis for cross-SMM collaboration.
- Next step: continue to improve algorithm efficiency and reliability, demonstrate effectiveness in PI/Co-PIs lab and in testbed provided by industry collaborators.

Engagement with SMMs:

- Conducted case studies of IIoT transitions for

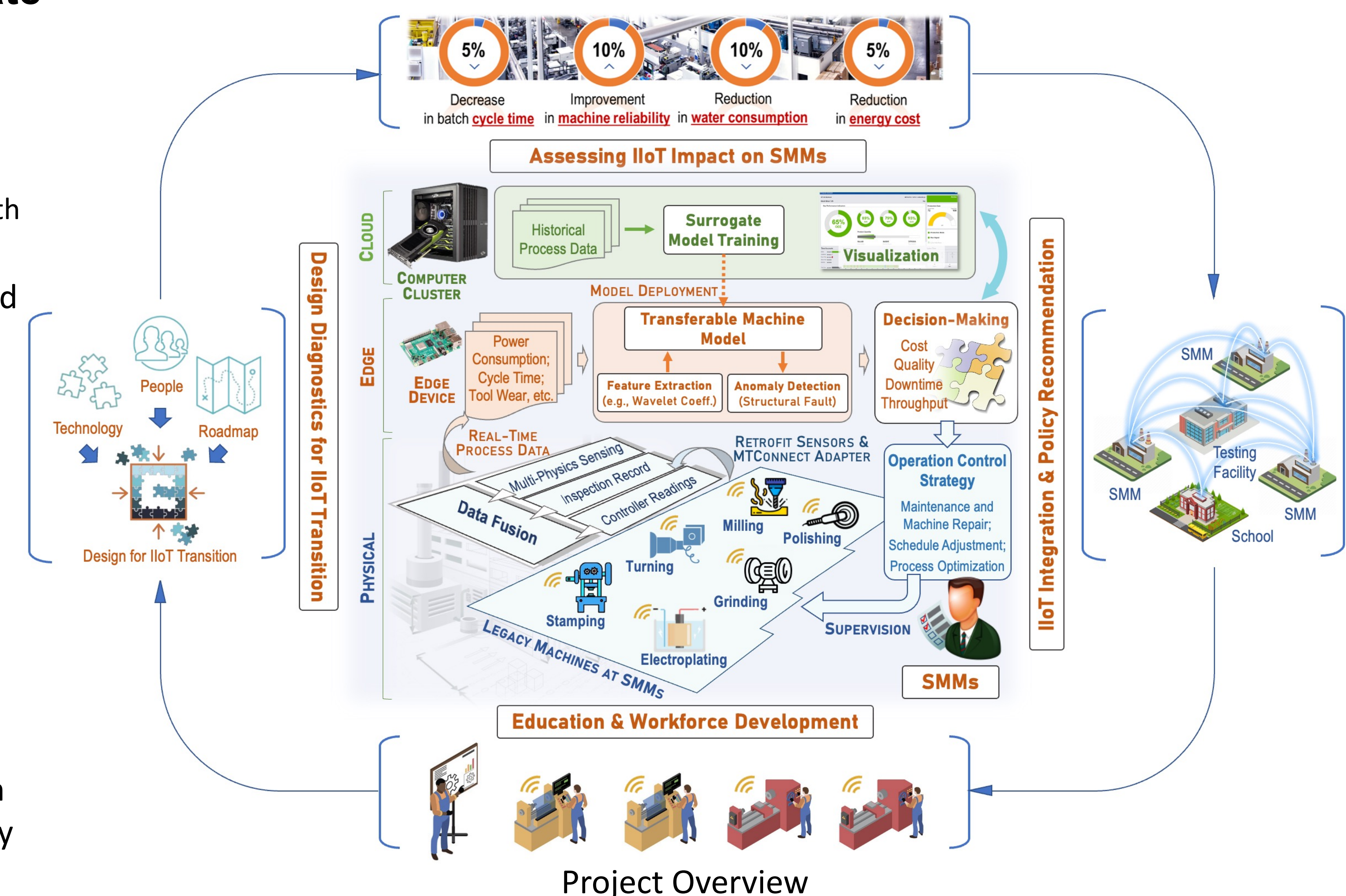
SMM on task, technology, structure, and people:

- ✓ held 21 meetings with industry partners and economic development groups;
- ✓ visited Jergens, Inc., a local SMM specialized in machining, to solicit feedback on engagement with a broad scope of SMMs.

- Next step: create white papers for case study, and for practical and policy implications of findings.

Education and workforce development:

- Held project meetings with local academic partners to discuss development of IIoT-related courses, and community developers on integration of technologies with testbed for workforce development.
- Next step: coordinate with education and industrial partners to set up SMM and test facilities as “living” labs to enhance community technology awareness, and to develop education module to grow and scale the labs for community engagement.



Publications

- [1] Zhang *et al.*, "Federated Learning for privacy-preserving collaboration in smart manufacturing", Proc. 18th GCSM, Berlin, Germany, 2022, Accepted
- [2] Eley and Lyytinen, "Industry 4.0 Implementation: Novel Issues and Directions", Proc 55th Hawaii Int. Conf. Syst. Sci, pp.5111–5120, 2022
- [3] Tian *et al.*, "Towards robust fingerprinting of relational databases by mitigating correlation attacks," IEEE Trans. Dependable Secure Comput. 2022, Accepted