

The Future of Work at the Human-Technology Frontier: Core Research

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The Future of Work at the Human Technology Frontier:

One of NSF's 10 Big Ideas



Harnessing the Data Revolution

Navigating the New Arctic

Quantum Leap

The Future of Work at the Human-Technology Frontier

Understanding the Rules of Life

Windows on the Universe



The Future of Work at the Human-Technology Frontier

NSF's investment in research on the future of work, focusing on research questions of technology innovation, workers, and the interdependencies of technology, human work, lifelong learning, and society, recognizing both opportunities and risks.

<https://www.nsf.gov/futureofwork.jsp>





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EHR AD: Karen Marrongelle

ENG AD: Dawn Tilbury

OIA OH: Suzi Iacono

SBE AD: Skip Lupia

Steering Committee Membership

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EHR: Evan Heit

ENG: Robert Stone†

SBE: Marc Sebrechts†

† *Steering Committee Co-Chairs*

Working Group Membership

CISE: David Corman, Andruid Kerne, Prabha Prabhakaran

EHR: Amy Baylor, Alex Medina-Borja, Chia Shen*, Katie Schreyer, Jack Butler

ENG: Jordan Berg*, Ruyan Guo, Robert Scheidt

OIA: Linda Molnar

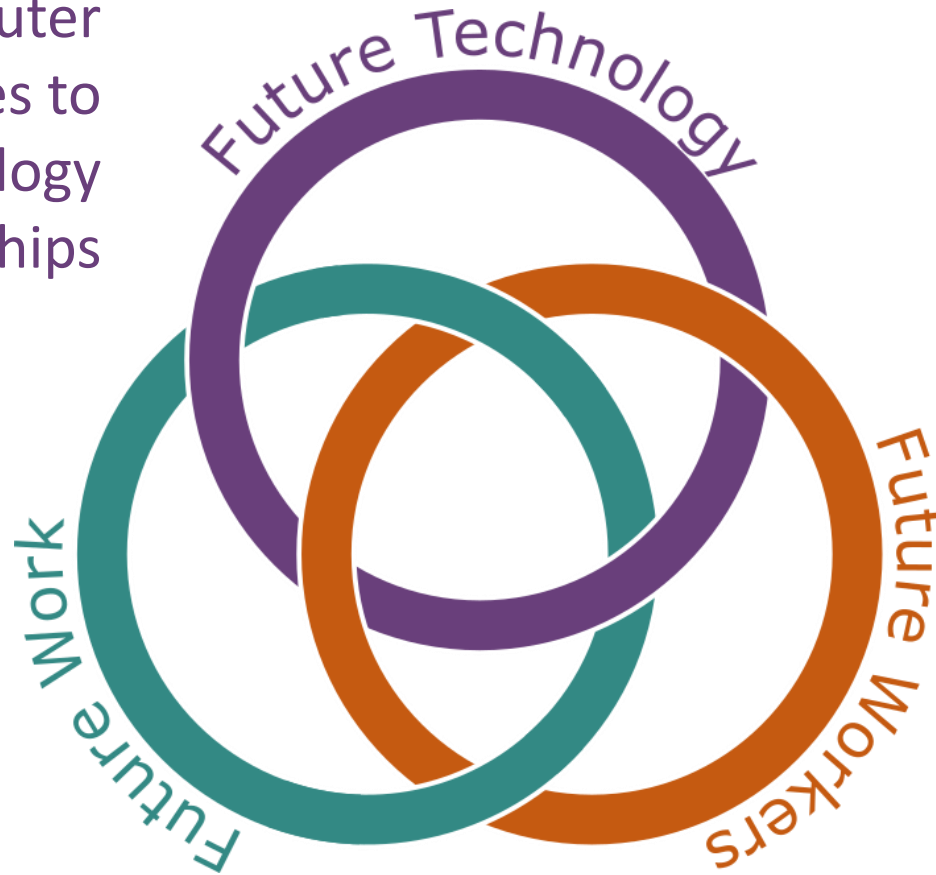
SBE: Georgia Chao, Sara Kiesler, Betty Tuller

* *Working Group Co-Chairs*

THE FUTURE OF WORK AT THE HUMAN-TECHNOLOGY FRONTIER

Engineering & computer science technologies to create human-technology work partnerships

Analyses of societal, economic, educational & national contexts, including benefits and risks



Research on education, training, & upskilling to ensure that current and future workers share in technology's benefits

Fundamental principles and support of individual workers, work teams, workplaces, & work organizations

FW-HTF: A Three-way Conversation

Future Technology: What capabilities should new tech have?

Future Work: How can tech strengthen this industry?

Future Worker: How will tech change life for workers?

- Answer 1: Series of Silos → Cut Costs, Replace Workers

- Tech: Create tech to duplicate the function of current workers

- Work: Use tech when they can do what workers do but cost less

- Worker: Automation will displace jobs

- Answer 2: Convergent → Higher Productivity, Workers More Valuable

- Tech: Where can tech make the best contribution? What research makes this possible?

- Worker: Can tech make workers happier and better at their job?

- Work: Can tech & workers partner to increase productivity & add value?



FW-HTF: Programmatic Overview

- FY 17: \$2M
 - 7 Workshops & 2 Research Coordination Networks
- FY 18: \$27M
 - 12 research projects
- FY 19: \$30M
 - 14 planning projects
 - 16 research projects
- FY 20: \$30M
 - 26 planning projects
 - 14 research projects
 - 3 Covid-19 RAPIDs/supplements



FW-HTF: Emerging Technologies in the Workplace

FW-HTF receives proposals addressing the workplace impact of...

- Virtual/Augmented/Mixed Reality
- Collaborative Robotics
- Machine Learning/AI
- Other ...



FW-HTF: Diverse Work Domains

- Manual Labor
 - Manufacturing, construction, agriculture, ...
- Knowledge Workers
 - Office work, medical, design, data analysis, software, engineering, ...
- Service Work
 - Retail, healthcare, ...
- Teachers
- Gig Workers
- Small Business
- Artists & Craftsmen



FW-HTF: Advancing Education & Training

- Upskilling workers to adapt to changing workplace
- Educating the next generation skilled technical workforce
- Enhanced training for improved productivity, safety, and agility
- Reskilling workers for career flexibility & economic stability



FW-HTF: Access & Inclusivity in the Workplace

- Accommodating Neurodiversity
 - 1928604, “Neurodiversity in Tech: Using Interactive Decision Theory and Augmented Reality to Enable Employment for Adults with Autism Spectrum Disorder,” Chukoskie.
- Physical & Cognitive Augmentation
 - 1930705, “Whole-body Exoskeletons for Advanced Vocational Enhancement (WEAVE),” Srinivasan.
- Access New Industries
 - 1928631/1928474/1928507/1928528, “Up-skilling and Re-skilling Marginalized Rural and Urban Digital Workers: AI-worker collaboration to access creative work,” Bigham/Savage/Callison-Burch/Hanrahan



FW-HTF: Research Translation

Connections to Convergence Accelerator Program (C-Accel)

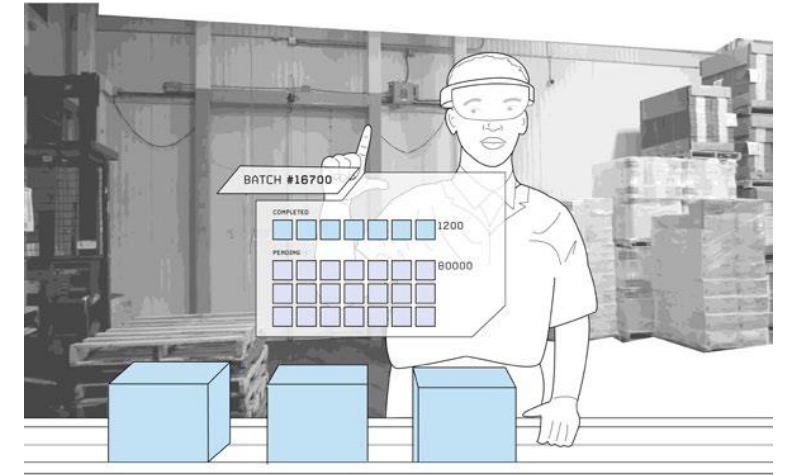
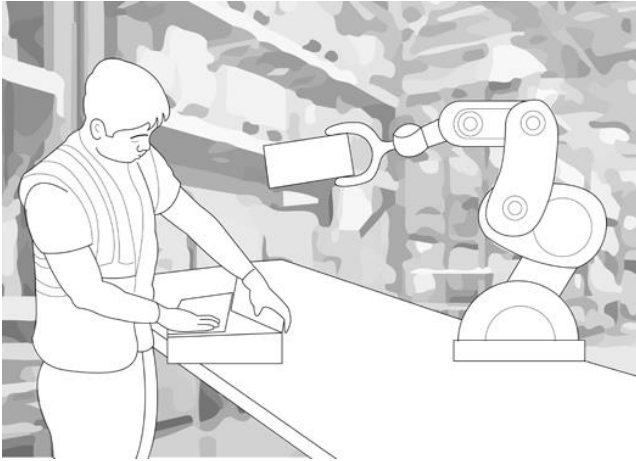
- New NSF program to:
 - accelerate use-inspired convergence research in areas of national importance, &
 - initiate convergence team-building capacity around exploratory, potentially high-risk proposals
- Track B in FY 19 C-Accel pilot featured FW-HTF themes
- Seek to maintain connections in the future
- <https://www.nsf.gov/od/oia/convergence-accelerator/index.jsp>



FW-HTF

Example Projects

FW-HTF: Collaborative Robots in the Seafood Processing Industry



Images courtesy Taskin Padir, Kristian Kloeckl, Northeastern University.

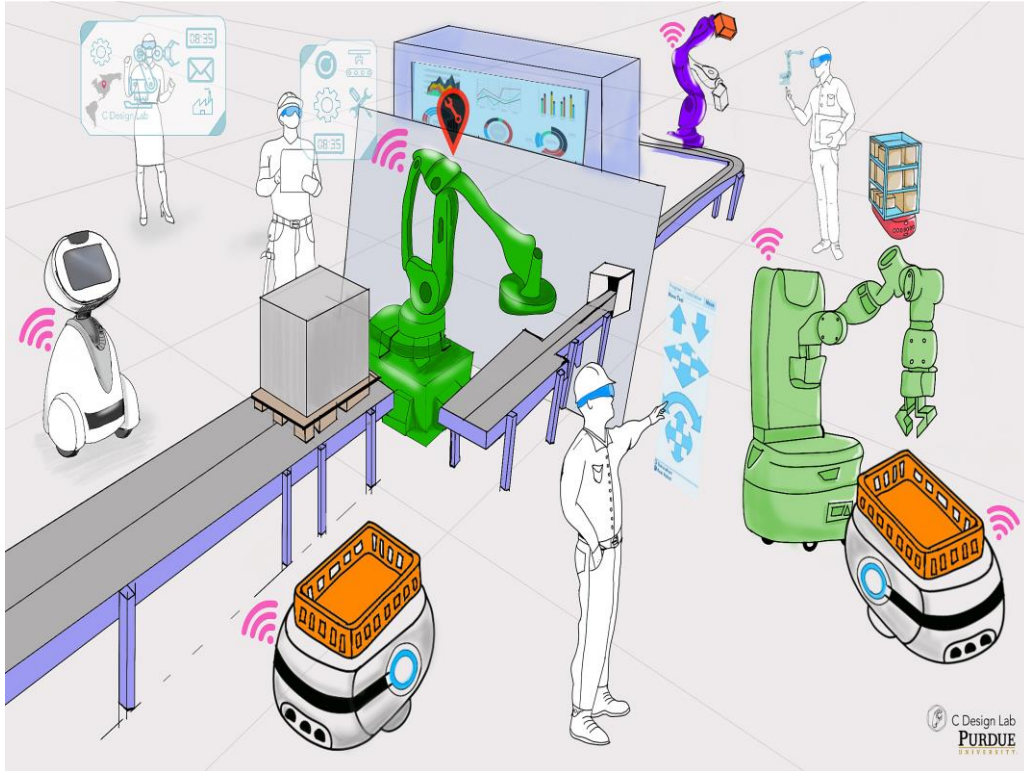
NSF ID 1928654, “Co-worker Robots to Impact Seafood Processing (CRISP): Designs, Tools and Methods for Enhanced Worker Experience,” PI: Padir

Researchers at Northeastern University are designing methods for humans and robots to work collaboratively in the seafood processing industry, for increased worker productivity, safety, and job satisfaction.

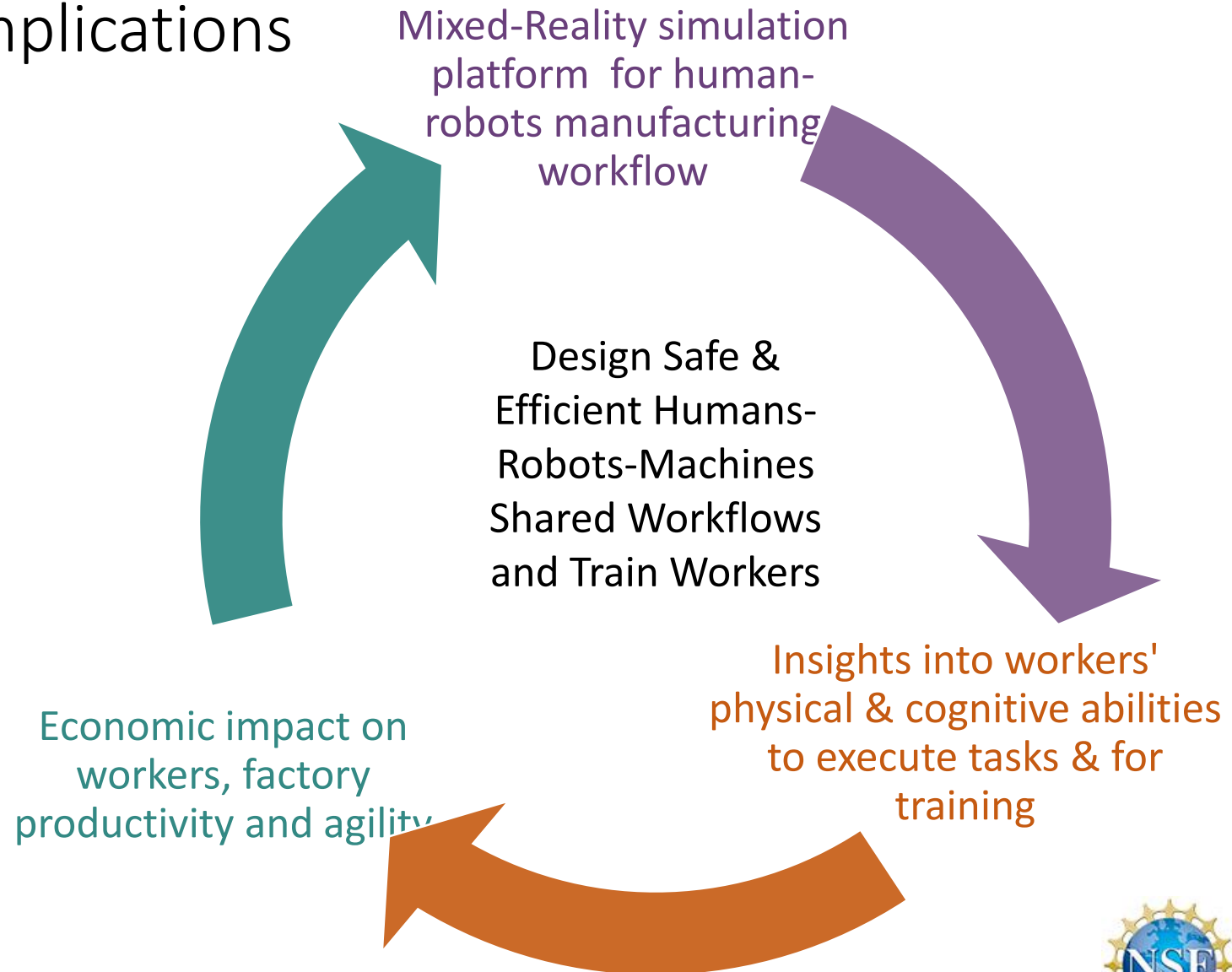
Economic and ethical workforce practices are analyzed to guide the potential on-shoring of a \$20 billion industry. The project investigates the best use of co-robots in worker training and up-skilling.



Designing Factory Human-Robot Workflows Using Mixed-Reality Simulation & Understanding Labor Force Implications



NSF ID: 1839921/1839971/1931227
PI: Ramani/Peppler/Acemoglu



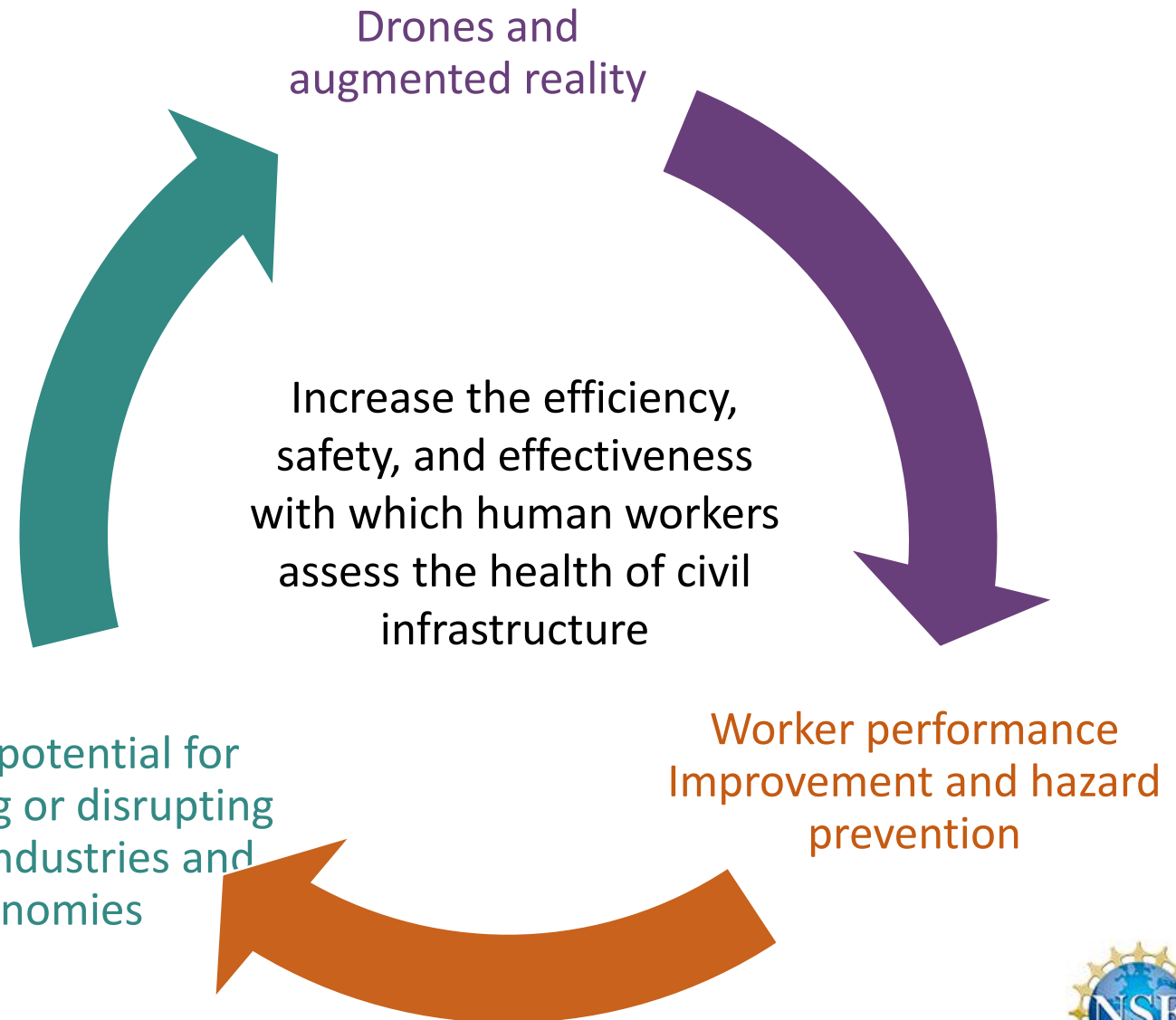
First Person View and Augmented Reality for Airborne Embodied Intelligent Cognitive Assistant



Images courtesy Craig Woolsey, Virginia Tech

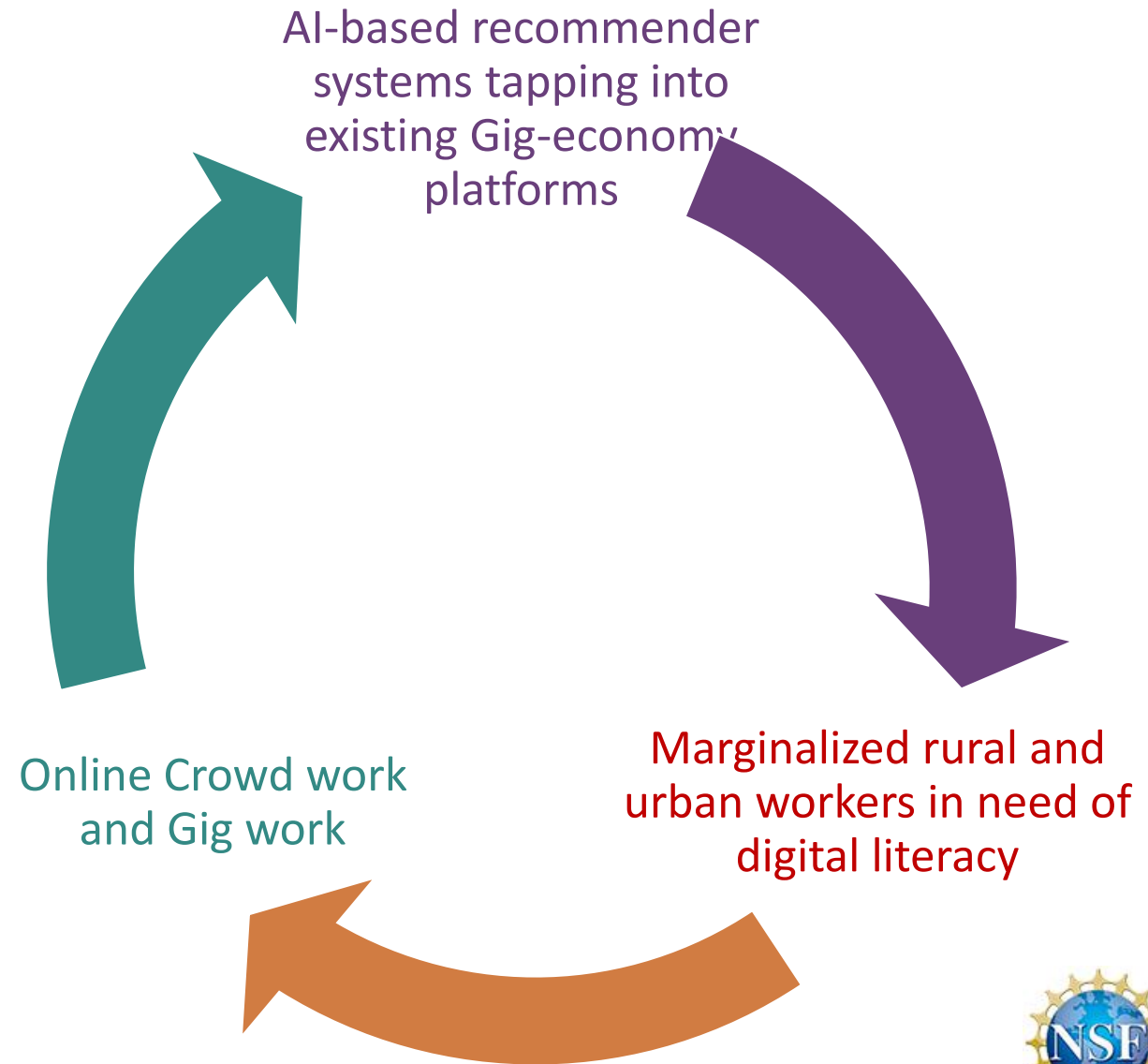
NSF ID: 1840044

PI: Woolsey



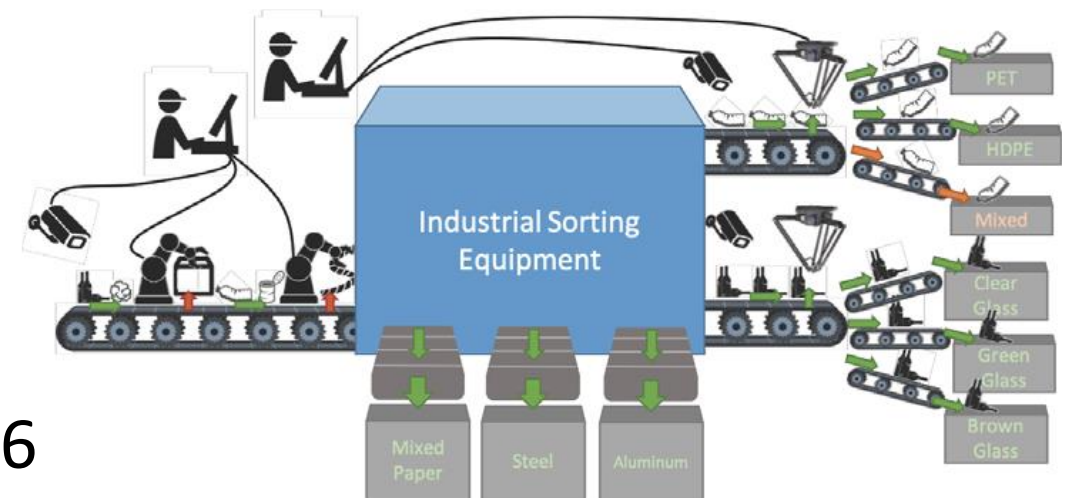
Up-skilling and Re-skilling Marginalized Rural and Urban Digital Workers: AI-worker collaboration to access creative work

- NSF ID: 1928631/1928474/1928507/1928528
- PIs: Bigham/Callison-Burch/Hanrahan/Savage
- Future of work includes new opportunities through online work and the gig economy. Many rural areas in the United States are plagued by a lack of economic opportunity. Urban areas may be geographically closer to opportunity, but workers similarly struggle to access it.
- Workers in depressed areas: Unskilled → basic digital skills for transcription, annotation, labeling → more advanced skills in stenography & data science → creative & entrepreneurial skills for new business development



Shared Autonomy for the Dull, Dirty, and Dangerous: Exploring Division of Labor for Humans and Robots to Transform the Recycling Sorting Industry

- The US scrap recycling industry -- \$117 billion in annual economic activity and more than 530,000 US jobs – struggles to meet increasingly challenging standards for accurate waste sorting
- Waste-sorting workers today face many health and physical risks
- Sorting plant architectures to optimize human-robot interaction to improve quality of product and worker safety and job satisfaction
- Facilitates physical distancing
- NSF ID: 1928448/1928477/1928506
- PI: Calli/Dollar/Saenko



Augmented Cognition for Teaching

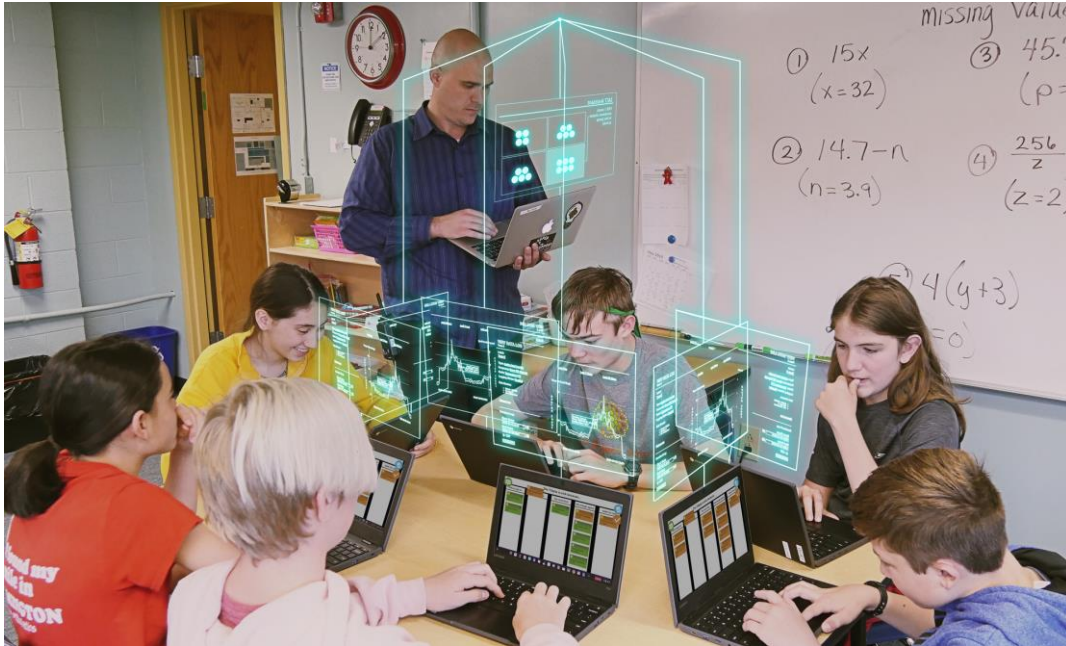


Image courtesy James Lester, North Carolina State Univ

NSF ID: 1840120/1839966

PI: Lester/Glazewski

AI to increase teacher
performance &
quality of work-life

**K12 Teaching: Assisting
preparatory, in-class and
retrospective pedagogical needs**

Teacher job satisfaction
and retention

Provide guidance
throughout the full
teaching workflow



Thank you!

Any questions?