

## Project Description

- develop an intelligent cognitive assistant embodied on whole-body exoskeletons
- augment human performance and improve work safety
- understand the socioeconomic consequences and policy implications of exoskeleton technology applications

Over the next decade nearly 3 ½ million manufacturing jobs will likely be needed

**2 Million** Are expected to go unfilled due to the **skills gap**

Creating a pressing, long-term issue for manufacturers

**78%** CEOs and manufacturing executives worldwide believe the inability to fill positions will impact their ability to **increase productivity**

Manufacturing will suffer

↓ **11%**  
Loss of annual earnings

**\$14,000**  
Cost for each unfilled position

Only 1.4 Million jobs are likely to be filled leading to an expected **2 Million** manufacturing jobs unfilled due to the skills gap

**3.4 Million** manufacturing jobs are likely to be needed over the next decade

## Future Technology

Powered, full-body exoskeletons

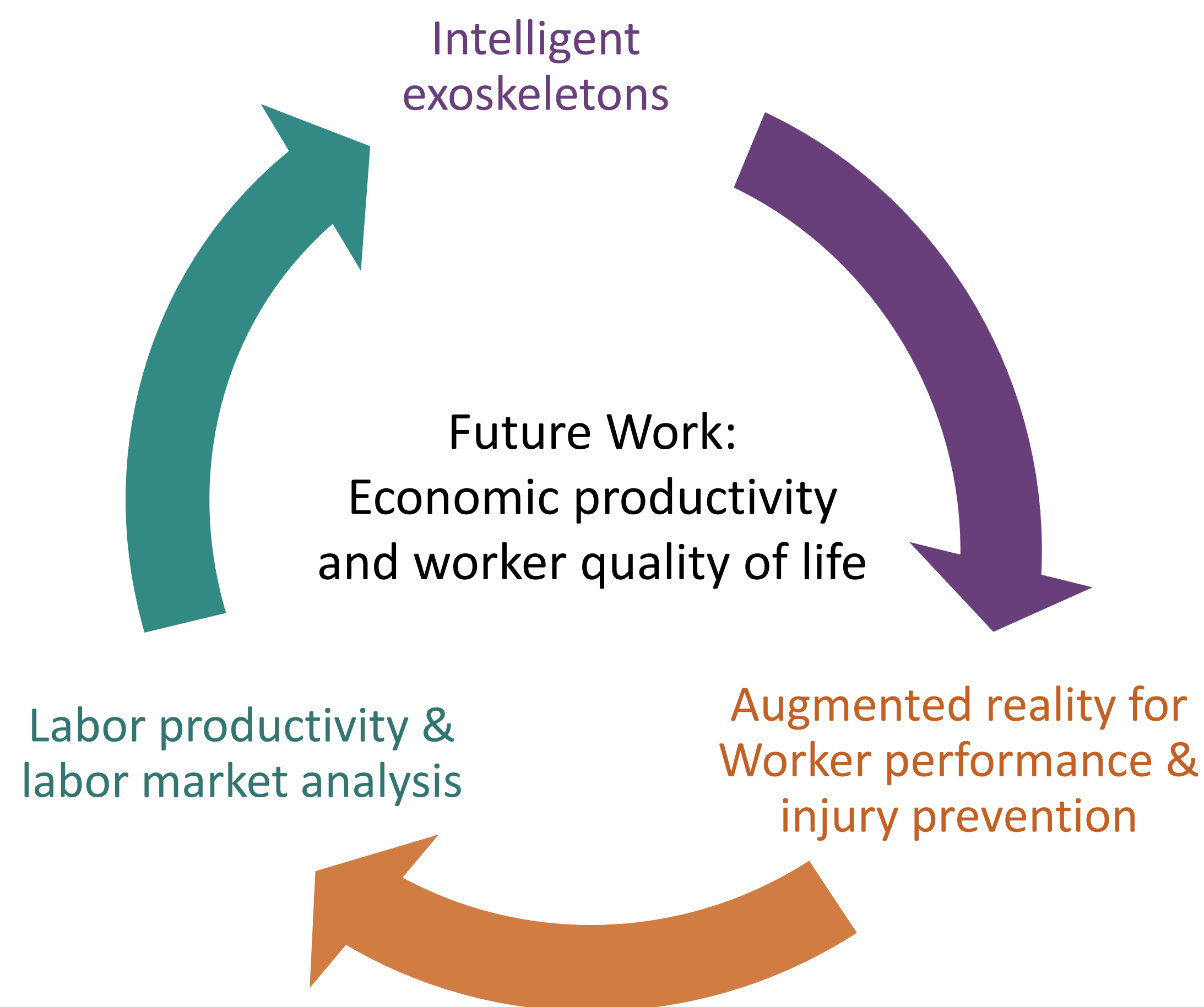
- provide the strength, dexterity, and precision
- preserve human skills
- increase productivity and lower injury risks
- equalize job opportunities for vulnerable populations

An augmented reality system

- enables the operator to fully access the capabilities of the exoskeleton
- improves worker performance and worker safety
- provides much broader access to some factory jobs for diverse populations



Convergence Research for Future of Work at the Human-Technology Frontier supported by the NSF



## Future Work

New technologies will reshape the landscape of work, and change

- job requirements, safety, and comfort
- worker performance and labor productivity
- worker health and longevity
- the labor market dynamics

## Transdisciplinary Research Team

VirginiaTech College of Engineering	Engineering Partners	Socio-Behavioral and Economics Sciences Partners
<b>Divya Srinivasan</b> Expertise: Human factors, motor control, biomechanics Role: Overall project leadership, human-in-the-loop considerations for technology design, human workload and performance assessments	<b>Nathan Lau</b> Expertise: Cognitive engineering, ecological interface design, cognitive work analysis Role: Cognitive assistance and interface development, cognitive workload assessments	<b>Suqin Ge</b> Expertise: Labor Economics, Applied Microeconomics Role: Productivity and labor market economic impacts of technology
<b>Dr. Alexander Leonessa</b> Expertise: Control systems, Robotics, System integration Role: Exoskeleton adaptive control design	<b>Maury Nussbaum</b> Expertise: Occupational biomechanics, workplace safety and injury prevention Role: Simulation of industrial tasks, injury risk and safety assessments	<b>Rupa Valdez</b> Expertise: Workplace disability, inclusive design, health disparities Role: Exoskeleton design considerations for disabled populations; technology implications for workforce diversification
<b>Alan Asbeck</b> Expertise: Wearable robotics, Mechatronic systems Role: Technology transfer for alternate exoskeleton designs	<b>Wallace Santos Lages</b> Expertise: Human computer interaction, mobile augmented reality interfaces Role: Augmented reality interface design	<b>Sunwook Kim</b> Expertise: Wearable technologies, biomechanics Role: Biomechanical evaluations, tasks setup and testing
<b>SARCOS Robotics</b> Expertise: Robotics and autonomy Role: Exoskeleton testbed provider, Project feedback	Engineering system design and integration Behavioral and cognitive sciences Economics	<b>UC SANTA BARBARA</b> DEPARTMENT OF COMMUNICATION <b>Norah Dunbar</b> Expertise: Inter-personal interaction, non-verbal communication, computer-mediated communication Role: Human-exoskeleton expectations and synchrony conceptualization and measures development

## Convergence Research and Policy

- Each component is a challenging research project.
- The interactions of the three components will provide truly transformative value and help facilitate policy making.
- Results of the economic analysis will guide the new capabilities that the engineer team will provide to the exoskeleton and the operator.
- The exoskeleton and the augmented reality system could mitigate cognitive disability and other challenges in the labor market, such as aging.

## Contact

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