



# Enhancing Individual Productivity and Capability

# Mission Statement



Increase individual productivity and  
capability through cognitive assistance

# Strategy



⌘ Augment every individual with teams of Agents and Robots

☑ Agents: Cognitive programs

☑ Robots: Cognitive machines

⌘ These teams of People, Agents, and Robots complement, assist, mentor, and monitor each other while collaborating together towards shared goals

# Benefits



## ⌘ Augment physical abilities

- ☑ Sensory

- ☑ Motor

- ☑ Limitations of proximity

## ⌘ Augment cognitive abilities

- ☑ Memory

- ☑ Problem solving

- ☑ Access to expertise and guidance

## ⌘ Reduce stress-induced performance degradation

## ⌘ Improve coordination across groups of people

# Example Impacts



## ⌘ Personal Teams

- ⏏ Life-long expert partners for everyday and business
  - ⏏ Assist, mentor, monitor, maintain, communicate, brainstorm

## ⌘ Independent Living

- ⏏ Enable seniors to live independently longer
  - ⏏ For example, augmenting memory and monitoring capabilities
- ⏏ Complementing capabilities of physically/mentally challenged

## ⌘ Military and Space Operations

- ⏏ Enables range of new concept of operations
- ⏏ Casualty reduction
  - ⏏ Sensors and robots in harm's way rather than people

## ⌘ Disaster Response

- ⏏ Safer, faster, more comprehensive search and rescue
- ⏏ Cross organization, level, community coordination
- ⏏ Reducing stress-induced performance degradation

# Additional Impact Areas



- ⌘ Lifelong one-on-one learning
- ⌘ Safer driving
- ⌘ Hazardous material cleanup
- ⌘ Counterterrorism
- ⌘ *And many more...*

# 10 Year Metrics



- ⌘ Increase productivity by 10 to 100 in critical tasks
- ⌘ Double overall societal productivity
- ⌘ Example area-specific metrics
  - ⌘ Personal Teams
    - ⌘ Cut mistakes in half (reducing time and accidents)
  - ⌘ Independent Living
    - ⌘ Extend by 5 years (save >\$5B/year)
  - ⌘ Military and Space Operations
    - ⌘ Military: Reduce allied casualties by an order of magnitude
    - ⌘ Space: Eliminate protective-gear induced cognitive distraction
  - ⌘ Disaster Response
    - ⌘ Double victims rescued within 48 hours

# Social Challenges



## ⌘ Trust

- ☑ Do what is expected
- ☑ Do something reasonable
- ☑ Don't divulge private information
- ☑ Don't let teammates down

## ⌘ Ownership

- ☑ Who owns partners
- ☑ Who owns what partners know (have learned)

## ⌘ Liability

## ⌘ Human Resentment of Technology



# Technical Challenges



⌘ Turn programs and machines into cognitive systems (agents and robots)

☑ Capable of understanding tasks and their context

☑ Acquiring and representing knowledge

- Learning from experience, data and instruction

☑ Inferring consequences of what is known and sensed

☑ Capable of solving problems and planning for the future

☑ Acting autonomously in a goal directed fashion

☑ Capable of communicating appropriately with others

☑ Using languages and modalities others can understand

☑ Asking for and providing appropriate information

☑ Explaining self to others

# Technical Challenges (2)



## ⌘ Teaming heterogeneous cognitive systems (people, agents, and robots)

- ☒ Dynamic team formation, adaptation, coordination and monitoring
  - ☒ Discovering and assigning participants, roles, tasks and resources
  - ☒ Training team to develop mutual trust and skill
  - ☒ Creating and maintaining appropriate organizational/C<sup>2</sup> structures
- ☒ Teammate support
  - ☒ Providing cognitive services (mentoring, bringing up to speed, etc.)
  - ☒ Acting dependably (doing what is expected/appropriate)
- ☒ Mixed initiative interaction
  - ☒ Adjusting level of autonomy (in all directions)
  - ☒ Managing attention demands and interrupts
  - ☒ Understanding and using concepts of authority and responsibility

# Summary



- ⌘ Vision of improved productivity and capability from cognitive assistance
  - ☑ Pervasive benefits for individuals and society
- ⌘ Radical technical vision for how people should work with computers
  - ☑ Collaboration among heterogeneous cognitive systems rather than interaction between users and tools