



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/C² 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