**Human-Systems Integration for Future of Work**

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Industry 4.0 increased AI, sensors, robots’ capabilities and fear of worker displacement.

We need Human-centered Automation/AI

### Ergonomics
- Shear Forces
  - Exoskeletons
  - Collaborative Robots
- Compression Loads
  - Semi-Autonomous Vehicles
  - Drones
  - Artificial Intelligence

### Workload
- Performance Under High Workload
- Different Responses Under Trust States
  - Reliable Robot Behavior
  - Unreliable Robot Behavior

### Trust
- Participants perceive & experience fatigue differently

### Support & Augment Human Capabilities
- Augmented or Virtual Reality Support
- Training
- Real-Time Monitoring
- Adaptive Visual Displays & Alerts
- Adaptive Task Allocations
- Improved Human-System Fluency

Collaboration can mitigate weakness or enhance strengths.

**INTEGRATE** human & systems rather than REPLACE humans.

Design systems at the intersection of the mind, motor, and machine.

**Human**
- Flexibility
- Improvisation
- Creative Decision Making
- Situation Awareness
- Sensing Capabilities

**Technology**
- Repeatability
- Endurance
- Computational Capacity
- Strength
- Uniformity

**Human Error**
- Slower Speed
- Fatigue
- Motivation

**Poor Under Uncertainty**
- Costly
- Hazardous

**Pertinent Human Factors Considerations**

Ignoring human factors

↓ Performance
↓ Safety
↑ Liability
↓ User Satisfaction

**Performance Under High Workload**
- Accuracy
- Sensitivity
- Specificity

**Shear Forces**
- L5S1 Inferior Anterior Shear
- L5S1 Superior Lateral Shear
- L3L4 Inferior Compression
- L3L4 Resultant Compression Loads

**Compression Loads**
- Shear Force (N)
- Control
- Exoskeleton

**Different Responses Under Trust States**
- Reliable Robot Behavior
- Unreliable Robot Behavior

**Participants perceive & experience fatigue differently**
- Tired
- Frustrated
- Overworked

**Ergonomics**

**Fatigue**

**Support & Augment Human Capabilities**

**Human-Systems Integration Across Applications**

**Aviation**

**Semi-Autonomous Vehicles**

**Exoskeletons**

**Collaborative Robots**

**Drones**

**Artificial Intelligence**

**Training**

**Real-Time Monitoring**

**Adaptive Visual Displays & Alerts**

**Adaptive Task Allocations**

**Improved Human-System Fluency**

**MIND MOTOR MACHINE**