HUMAN FACTORS AND OPERATIONAL INTEGRATION OF UNMANNED MEDICAL EVACUATION SYSTEMS

A Conceptual Framework for Distributed Human-Automation Joint Cognitive System

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Non-Disclosure

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THE PARADIGM SHIFT

HUMANS WORK WITH HUMANS

Collaboration, communication, and shared situational awareness.

MACHINE “IN THE MIDDLE”

Autonomous systems operating alongside humans, bridging capability and reach.

While preparing this presentation....

ABC NEWS • Live Video Shows Good Morning America ShopGMA

Unmanned drone boat rescues 2 US crew members after helicopter downed by Iranian drone

Trump said the military informed him Iran was to blame for the helicopter crash.

By Luis Martinez
June 9, 2026, 10:11 PM

Why this rescue changes military operations

The Corsair's speed, range, and autonomous capabilities allowed it to operate in a volatile area without risking additional personnel. Defence analysts note that such technology could transform casualty evacuation, freeing up soldiers for combat and enabling rescues in high-threat zones. The precedent aligns with broader trends in drone warfare, where unmanned systems are increasingly adapted for diverse roles beyond surveillance. ABC News Australia + 2

AUTOMATION LEVELS

FOR UNMANNED SYSTEMS

LEVEL 1

TELEOPERATION

Full Human Control

LEVEL 2

SUPERVISED AUTONOMY

System performs tasks under supervision and authorizations.

LEVEL 3

CONDITIONAL AUTONOMY

Human Set Target and Supervise

LEVEL 4

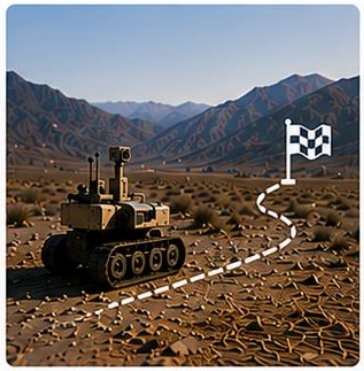
HIGH AUTONOMY

Human Set Target and Supervise (Automatic Mission Planning)

LEVEL 5

FULL AUTONOMY

Human Defines the Working Framework and Safety Margins



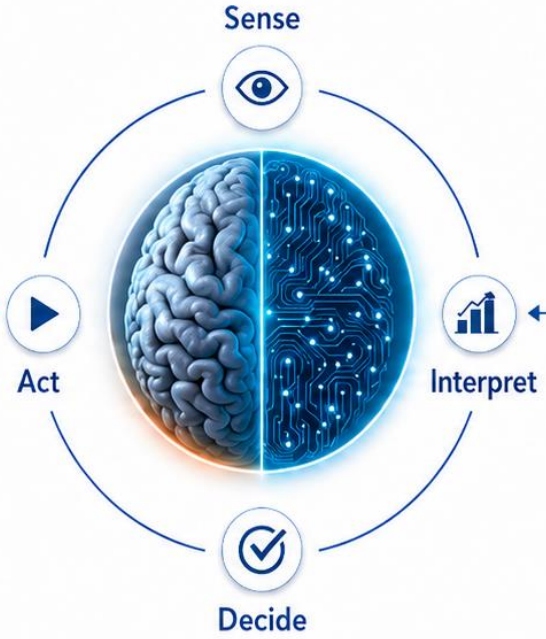
INCREASING LEVEL OF AUTOMATION

THE DISTRIBUTED HUMAN-AUTOMATION SYSTEM

HUMAN ACTORS

- Frontline Medics & Soldiers
- Remote Vehicle Operators
- Remote Clinicians
- Commanders

SHARED COGNITIVE LOAD



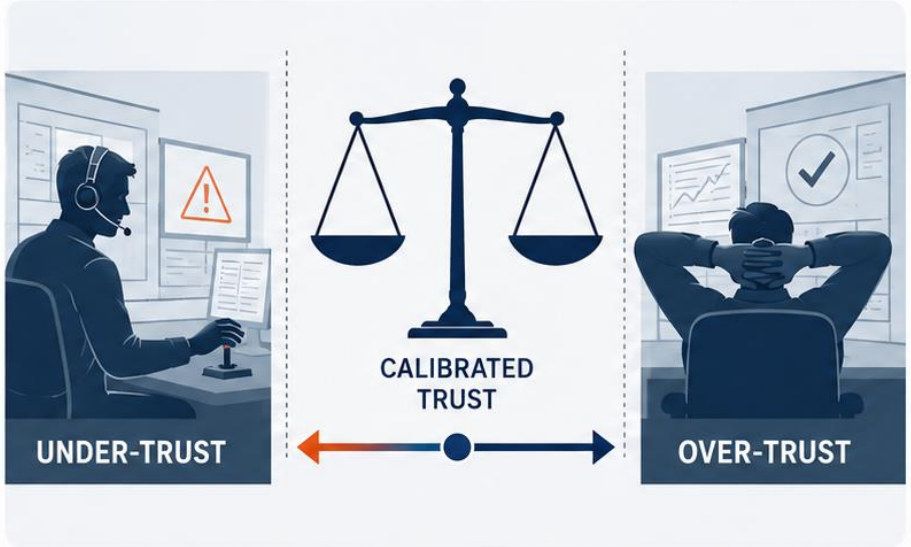
AUTOMATION CONTRIBUTIONS

- Monitoring & Alerts
- Data Fusion
- Decision Support
- Navigation / Control

TRUST & RELIANCE

UNDER-TRUST

Operators override otherwise reliable automation, increasing workload, cognitive burden, and operational risk.



OVER-TRUST

Excessive reliance can lead to complacency and automation bias, particularly during system degradation or failure.

TRUST ASYMMETRY

Trust declines rapidly following failures, but is rebuilt only gradually over time.

Warning!

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WORKLOAD & SITUATIONAL AWARENESS

HUMAN INTERACTION AT THE CASUALTY SITE

Non-expert users must be able to interact with unfamiliar platforms under stress

Need for clear behavioral cues: visual signals, voice instructions, and simplified operation

HUMAN-CENTERED DESIGN IS A SAFETY REQUIREMENT, NOT AN OPTION

ETHICS & RESPONSIBILITY

Who is accountable for a patient condition during autonomous transport?

ETHICS & RESPONSIBILITY

Risk of over-relying on clinical decision-support systems during triage.

Distributed systems can lead to a dangerous diffusion of accountability.

NEED: Clear Governance Frameworks and Responsibility Boundaries

HUMAN FACTORS FRAMEWORK

UNMANNED MEDICAL EVACUATION SYSTEMS

OPERATIONAL ENVIRONMENT

HUMAN ACTORS

- Remote Clinicians
- Platform Operators
- Command
- Medics / Personnel On-Site

The Human-Automation Joint Cognitive System

AUTOMATION & SYSTEMS

- UAV / UGV / UMV Platforms
- Autonomous Medical Care
- Area Control / Navigation
- Communication Network

HUMAN FACTORS DYNAMICS

- Trust & Reliance
- Workload Management
- Situation Awareness
- Ethical Responsibility

CLINICAL & OPERATIONAL OUTCOMES

- Time on Target
- Safety
- Evacuation Time
- Medical Outcomes
- System Reliability
- System Utilization and Acceptance

PAIRING SOLUTIONS WITH HUMAN FACTORS

Handover

Clear and Simple human-machine contact

Situational Awareness

Multi-Modal feedback and advisory

Reliability

Fail-safe and autonomy backup

Trust

Transparency and predictability

Workload

Adaptive levels of automation

Training

Scenario-based VR/AR training

RESEARCH GAPS & FUTURE AGENDA

Cognitive Workload Limits
No empirical benchmarks for remote supervisory capacity.

Personnel Acceptance
Attitudes of military medical staff toward unmanned evacuation.

Ethical Governance
Clinical accountability frameworks for autonomous transport.

Joint Cognitive Systems Approach

Autonomy
Modeling autonomous robotic medical care.

Situational Awareness
Multimodal feedback and advisory systems.

Long Distance Evacuation
LEO and lunar evacuation scenarios.

WORK IN PROGRESS

Physiological Digital Twins

Building patient-specific digital twins to model physiology and predict response to robotic care.

Robotic Care Modeling

Simulating closed-loop support for interventions such as fluids, ventilation, and drug delivery.

VR/AR Integration

Combining immersive VR and AR environments with digital twin capabilities for training and system testing.

Human Factors Validation

Evaluating workload, trust, and situational awareness in human–automation interaction.

Ben-Gurion University of the Negev
Faculty of Health Sciences | Human Factors Lab

TAKE HOME ITEMS

Unmanned MEDEVAC is not only a technological challenge, but it is also fundamentally a **Human–Automation integration challenge.**

Future medical evacuation systems will require a transition from traditional Human–to–Human and Machine coordination toward a **Human–Machine Joint Cognitive System.**

Human operators will remain essential, but their role will evolve from direct control toward **supervision, mission management, and cognitive oversight.**

The future of autonomous medical evacuation (and in general robotic medical care) depends on system design **to support human cognition rather than replacing it.**

“The future of autonomous medical evacuation will be determined not by how autonomous the machine becomes, but by how effectively humans and automation think, adapt, and operate together.”

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