Potential Game Changers Through 2035 *(The Era of Accelerated Human Progress)*

Robotics
40+ countries develop military robots with some level of autonomy. Impact on society, employment.
Vulnerable: Cyber/EM disruption, power systems, ethics without man in the loop.
Formats: Unmanned/Autonomous; ground/air vehicles/subsurface/sea systems. Nano-weapons.
Examples: (Air) Hunter/killer UAV swarms; (Ground) Russian Uran: Recon, ATGMs, SAMs.

Artificial Intelligence
Human-Agent Teaming, i.e., where humans and intelligent systems work together to achieve either a physical or mental task. Human and the intelligent system will trade off cognitive and physical loads in a collaborative fashion.

Computing
Human computer interaction transformed, processing power increases exponentially;
Interface: From mouse/keyboard/wearables to digital telepathy, centaur systems.
Quantum Computing: From 1&0 binary coding to quantum superpositions & entanglement (e.g., 0 and 1 at same time).
Big Data: Quantum computing using advanced predictive algorithms/sensing, Internet of Things (IoT) enabled. Must protect against deception.
Sentient Data: Pinpoints who can/cannot access and interact with, without human intervention.

Cyber
Self-configuring, self-protecting computer systems and networks.

Logistics/Additive Manufacturing
Ability to print materiel, in theater, on an as-needed basis.
Example: Print a small drone with specific capabilities for a mission in 24 hours.

Electronic Warfare
**Radar Jammers**: Sophisticated noise or repeaters.
Convergence of RF+Cyber through software defined radios. Controlled modulation can make signals look like noise to interceptors.

Advanced ATGM & MANPADS
Extended range. Proliferate more rapidly than Active Protection systems develop, putting armored vehicles and helicopters at risk.

Chemical Weapons
Non-traditional agents developed to defeat detection and protection capabilities.
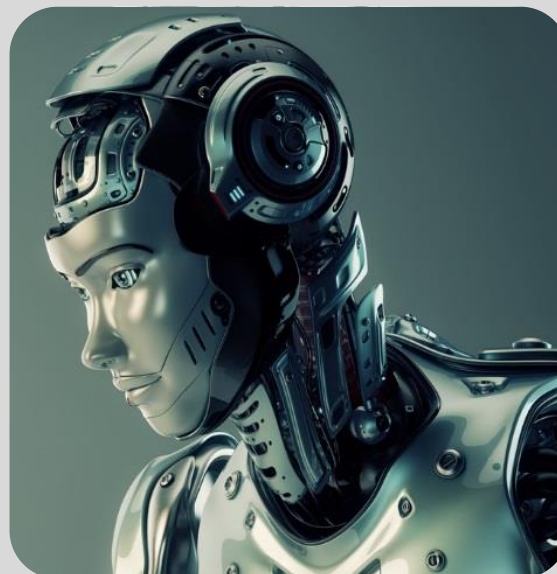
Swarms/Semi Autonomous
Massed, coordinated, fast, collaborative, small, stand-off. Overwhelm target systems. Mass or disaggregate.

Internet of Things (IoT)
Trillions of internet linked items create opportunities and vulnerabilities.
Explosive growth in low Size Weight and Power (SWaP) connected devices (Internet of Battlefield Things), especially for sensor applications (situational awareness). Greater than 100 devices per human. Significant end device processing (sensor analytics, sensor to shooter, supply chain management).
Vulnerable: Cyber/EM/Power disruption. Privacy concerns regarding location and tracking.
Sensor to shooter: Accelerate kill chain, data processing and decision making.

Camouflage, Cover, Concealment, Denial and Deception
Low tech to high tech means to create uncertainty for adversaries, proliferating widely. **Obscurants/Thermal Paint** Confuse sensors. **Redirected Energy**: Hyper stealth invisibility, Electromagnetic illusion. (Revolutionary) **Decoys**: Must deceive multi-disciplined intelligence.

Space
Over 50 nations operate in space, increasingly congested and difficult to monitor, endanger PNT; **GPS Jamming/Spoofing**: Increasingly sophisticated, used successfully in Ukraine; **Anti Satellite**: China has tested two direct ascent anti-satellite missiles.

Cannon/Rocket Artillery
Long range artillery, hardened GPS munitions, Point air defense systems defend against PGM.

Missiles
Developed for greater range and improved accuracy using inertial guidance.

Potential Game Changers through 2050 *(The Era of Contested Equality)*

Convergence – The intersection or merging of many new and potentially revolutionary technologies will create exponential change in the operational environment.

Hyper Velocity Weapons

Rail Guns (Electrodynamic Kinetic Energy Weapons)

Electromagnetic projectile launchers: High velocity/energy and space (**Mach 5** or higher). Not powered by explosive.

No Propellant: Easier to store and handle.

Lower Cost Projectiles: Potentially. Extreme G-force requires sturdy payloads.

Limiting factors: Power. Significant IR signature. Materials science.

Hyper Glide Vehicles: Less susceptible to anti ballistic missile countermeasures.

Directed Energy Weapons

Signature not visible without technology, must dwell on target. Power requirements currently problematic.

Potential: Tunable, lethal, and non-lethal.

Laser: Directed energy damages intended target. Targets: Counter Aircraft, UAS, Missiles, Projectiles, Sensors, Swarms.

RF: Attack targets across the frequency spectrum. Targets: Not just RF: Microwave weapons "cook targets," people, electronics.

Power

Critical driver of future capabilities. Storage/production increases despite getting smaller/lighter.

Strategies: Renewables, reduce consumption, increased storage and generation.

Thin / Super Capacitors: Store exponentially more energy and recharge faster.

Hybrid Renewable Energy: Combining two or more renewable energy sources.

Wireless: Power and charging over the air (long distances).

Synthetic Biology

Engineering / modification of biological entities

Increased Crop Yield: Potential to reduce food scarcity.

Weaponization: Potential for micro-targeting, Seek & destroy microbes that can target DNA. Potentially accessible to super-empowered individuals.

Medical Advances: Enhance soldier survivability.

Genetic Modification: Disease resistant, potentially designer babies and super athletes/soldiers. Synthetic DNA stores digital data. Data can be used for micro-targeting.

CRISPR: Genome editing.

Energetics

Defines the relationships of the flow and storage of energy.

LENR: Low Energy Nuclear Reactions

Insensitive Munitions: Chemically stable munitions withstand shock, fire, projectiles; yet explode as intended.

Nano Materials: Miniaturized power sources; reduce bulk, increase yield.

Information Environment

Use IoT and sensors to harness the flow of information for situational understanding and decision making advantage.