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

Robotics

40+ countries develop military robots with some level of autonomy.
Vulnerable: Cyber/EM disruption, power systems, ethics without man in the loop/transfer of responsibility to machines.
Formats: Unmanned/Autonomous; ground/air/subsurface/sea systems. Nano-weapons. “Legged” locomotion and robotic dexterity.
Examples: Russian Uran-9.

Swarms/Semi Autonomous

Massed, coordinated, fast, collaborative, small, stand-off. Overwhelm target systems.

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 to quantum superpositions & entanglement (0 and 1 at same time) enabling ultra-precise timing, improved sensing, and security.
Big Data: Quantum computing using advanced predictive algorithms/sensing; biometric data.
Sentient Data: Pinpoints who can/cannot access and interact with, without human intervention. Reasoning machines.

Cyber

Self-configuring, self-protecting, and self-healing systems and networks. Machine learning.

Logistics/Additive Manufacturing

Ability to print materiel on an as-needed basis. Artificial semi-conductor materials, quantum optics for smaller/more responsive IR sensors.

Electronic Warfare

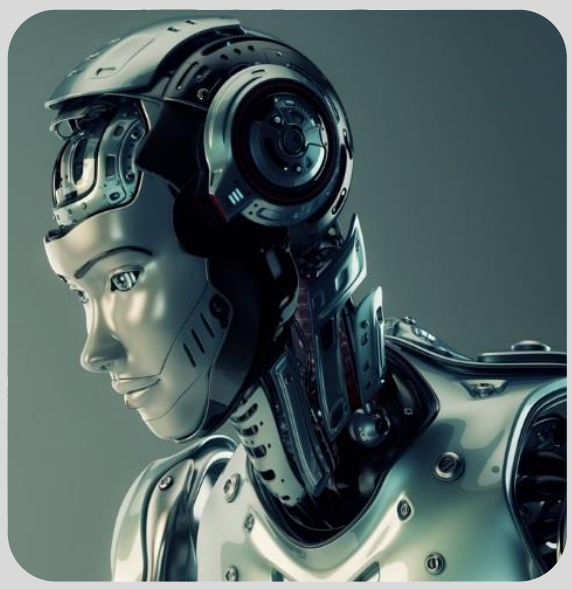
Radar Jammers: Sophisticated noise or repeaters. **Convergence** of RF+Cyber through software defined radios. Controlled modulation can make signals look like noise to interceptors.

Advanced ATGM & MANPADS

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

Chemical Weapons

Non-traditional and synthetic agents developed to defeat detection and protection capabilities.



Artificial Intelligence

Human-Agent Teaming, i.e., where humans and intelligent systems work together to achieve a physical or mental task. Brain-to-AI interfaces enable high-performance warfighting.
Weaponized Information enabled by AI that deliberately misrepresents voice and video to influence political, financial, and military areas, potential vulnerability as humans rely more on AI-driven systems.

Internet of Things (IoT)

Trillions of internet linked items create opportunities and vulnerabilities. Linked with 5G. Explosive growth in low Size Weight and Power (SWaP) connected devices (Internet of Battlefield Things), especially for sensor applications (situational awareness). Internet of Autonomous Things (IoAT) continues to operate when network connection is broken. 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, Deception

Low-tech to high-tech means create uncertainty for adversaries, proliferating widely. **Obscurants/Thermal Paint** confuse sensors. **Redirected Energy**: Hyper stealth invisibility, Electromagnetic illusion (cloaking). **Decoys**: Must deceive multi-disciplined intelligence.

Space

Over 70 nations operate in space, increasingly congested and difficult to monitor, endangering space-based assets that provide 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, autonomous guidance.

Missiles

Maneuverable and 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: 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. Power requirements currently problematic.
Potential: Tunable, lethal, and non-lethal.
Laser: Directed energy damages intended target. Targets: Counter Aircraft, UAS, Missiles, Projectiles, Sensors, Swarms. Must dwell on target.
RF: Attack targets across the frequency spectrum.
Targets: Not just RF: Microwave weapons "cook targets," people, electronics.

Energetics

Defines the relationships of the flow and storage of energy.
Insensitive Munitions: Chemically stable munitions withstand shock, fire, projectiles; yet explode as intended. Tailorable and multifunctional.
Nano Materials: Miniaturized power sources; reduce bulk, increase yield.

Power

Storage/production increases despite getting smaller/lighter. Electric/battery-powered vehicles.
Thin / Super Capacitors: Store exponentially more energy and recharge faster.
Hybrid Renewable: Combining renewable energy sources.
Wireless: Power and charging over the air (long distances), laser charging.
Nuclear: small modular advanced nuclear power via DE and electric transportation.
Thermionic: Harvesting at nano level scalable to megawatts.

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: Enhance Soldier survivability, artificial cells produced on-demand. Tailored vaccines.
Genetic Modification: Disease-resistant super athletes/Soldiers. Synthetic DNA stores digital data which can be used for micro-targeting. Turning benign microbes into pathogens. **CRISPR**: Genome editing.

Information Environment

Use IoT and sensors to harness the flow of information for situational understanding and decision-making advantage. Instantaneous recall, sensor-saturated environment, unmanned asset intelligence collection, algorithmic processing of high volumes of information, virtual and augmented reality.