The Next Generation
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ET-Trends

Welcome to the **Next Generation**, a new column that will take you into the future. Most futurists venture about 50 years ahead, but like Star Trek, we'll travel a few centuries into many future worlds. Topics will vary widely, from healthcare to machines of war, from inner space to outer space, but always with a technical focus. While technology will change the way we carry out business and the way we live, human nature will remain mostly constant. Welcome to the 23rd century.

The End Game

Mankind has built *engines of war* from the dawn of recorded history, to defend and protect, but also to conquer and destroy. Technology has often played the critical role making it the decisive factor. History has shown that victory more often went to those with the best technology. These lessons were not forgotten by future generations who continue to invest in engines of war that multiply their forces. Some hold a vision that the ultimate winner will be an *army of one* – or perhaps an *army of none!*

During the 21st century, military strategists embraced the unmanned war machine theme and succeeded in building impressive robotic warriors (RW) that mostly traversed the skies under the control of ground-based "pilots". The ancient Global Hawk, known as an unmanned aerial vehicle (UAV), could autonomously navigate and carry out a programmed mission, staying aloft for up to 40 hours. By the end of that century, the UAVs had become the dominant engines of war and piloted military craft were becoming an exception. Refuellers and observation command groups still used manned aircraft, but even that would change.

By the 22nd century, the RWs had become the military standard as materials, power plants, communications, and weaponry advanced. The typical aircraft used hybrid solar power for transportation making flight duration essentially limitless. Solar fabric, woven of photovoltaic polymers, was deployed by these high-flying vehicles during non-battle periods of daylight allowing night flying using chemically stored energy. While most of the essential technology was known a century earlier, advances in material science, sensors, and electro-photonics were the enablers. No longer, was in-flight fueling required, but "repair in air" kept them flying. Large transports, not much different from the slow-moving 20th century designs, "snagged" RWs, pulled them into massive cargo bays, performed maintenance, and set them free to continue on missions. Flight records were measured in years for pilotless craft.

By the 23rd century, virtually all military aircraft were unmanned. Observers and commanders, of course, could operate from low earth orbit, using aerospace "planes" that reminded historians of early Space Shuttles. But the focus was on unmanned machines that endlessly patrolled the skies. Made mostly of polymers, including their electric power plants, they were undetectable accept for the most advanced airborne photonic "radar". Since weaponry consisted primarily of energy beams, especially lasers powered by super-capacitors charged by solar, the stealth factor was better than 99.5%. While ground-based power plants used fusion, no one could provide a timetable for when such power might be miniaturized enough for airborne. Most believed that the first fusion-powered transports would be ships, just as it had been for fission. The tens of thousands of RWs patrolling the skies at any given time, turned out to be

much less of a “conflict deterrent” than the old nukes of the 20th century. Doing battle with 100-KW beam weapons was not likely to end the world and the machines were expendable.

The aircraft sense-analyze-control (SAC) systems had long ago moved to deposited electro-photonics (DEP). The old chip-package-board paradigm had vanished many decades ago. Nanomechanics was used to apply mostly organic electro- and photonic- polymers on housing used to build the WRs. Some SACs were applied to interior surfaces, but many of the sensor systems were on external surfaces. The “package”, so popular during the 20th and 21st centuries, had all but disappeared unless one counted the final top coat that was reminiscent of the old conformal coatings once used for ancient military electronics. But since the organic materials are mostly hydrophobic, only modest protection is needed. And with virtually no metals used for electro-interconnect, corrosion issues are inconsequential. Of course, photonic links are made of polymers precisely applied by nano-deposition and finished with nano-lasers. Most airborne vehicles are built of graphene composites that make an ideal surface for deposited electrophotonics.

Some had believed that the nanotech revolution of the 21st century would be based on carbon nanotubes, but macrochemisrty has served us well although nanoprinters and dispensers now dominate the fabrication industry. Not surprisingly, the entire sensor-logic-control-interconnect system can be a monolithic integrated unit, directly “printed” onto a machine, or produced as a freestanding film that can be rolled or folded for volumetric efficiency. Metal is no longer used in elemental form although some organometallic compounds find use in sensors.

The most advanced RWs seek-analyze-react (SAR) semi-autonomously so that ground and aerospace communications are still important. Photonics is preferred, with its extraordinary bandwidth and the high security, but RF still has a place. Technologists are ready to send up fully autonomous vehicles, but this seems unlikely unless the world-ruling entities can agree on “robot rules”. The world would move from *War Bots* to *Robo Cops*, a concept fraught with anxiety. The #1 question, “Could a single hacker take over the world?”