Chapter 11

Recommendations

The study group identified cross-cutting (universal) technologies, made a first-order assessment of technologies available or needed for specific applications, and suggested a roadmap for technology development. Some recommendations for technology base programs were made. Moreover, the study group determined the need to aggressively pursue both development and demonstration programs. The following 11 recommendations summarize the actions needed now to realize the potential of UAVs.

Recommendation 1 - ***Take the lead role in programs to expand the missions of the near-term (T2, T2+, T3-) UAVs in Air Force, Joint, and National roles.*** These aircraft can serve many additional force enhancement roles, offering the economy of quantity production. Palletized payload bays can provide for roll-on, roll-off missionized approaches. Some relatively near-term possibilities for demonstration are:

- Enhanced ISR payloads, including advanced radars and multiplatform precision emitter location, including onboard processing to reduce downlink data rates and facilitate the interpretation and exploitation of collected information.

- Virtual ABCCC (ESC Initiative) - Relays all communications to rear ground location. Brings crew to a safe haven.

- UAV Communications Node (Army/DARPA Initiative) - Provides self-deploying (no need for in-theater support structure) communications support to early-entry forces. Might also provide GPS augmentation as a solution to jamming vulnerabilities.

- Target Engagement Support (direct targeting support to the shooter) - Goes beyond the current reconnaissance-surveillance roles for the Tier aircraft to a role of Joint STARS extension for real-time target selection, weapon assignment, and attack (particularly useful for time-critical targets).

- Virtual Rivet Joint with TDOA precision emitter location - Receivers operated remotely from ground sites, with collected SIGINT relayed to ground exploitation centers or targeting facilities. Brings crew to a safe haven.

Recommendation 2 - ***Pursue the SEAD mission as an early application of UAVs in an attack role:***

- Initiate design studies to define a low life-cycle cost operational SEAD vehicle using the SAB-developed point design as a starting point.

- Build a few SEAD cued attack UAVs with avionics and weapons in an ACTD structure to develop operational concepts for SEAD UAVs as adjuncts to manned aircraft.

- Conduct operational evaluations of the effectiveness and utility of the SEAD UAV system.

- The SEAD vehicle relies on a precision emitter location capability (recommended as a growth ISR UAV payload) or other precision cue.

Recommendation 3 - ***Initiate a program, perhaps with DARPA, that leads to the development and deployment of penetrating combat UAVs in the mid- to far-term.***

- Employ existing manned fighter aircraft as test beds to explore and define the requirements, technologies, and operations concepts necessary to remove the pilot from the cockpit.

- Exploit performance UAV technologies and life-cycle cost methods, as well as manned vehicle technology advances, to design a new, low-cost, operational combat UAV system.

Recommendation 4 - ***Increase emphasis on effective techniques for flight management and employment of UAVs.***

- Support research in cognitive sciences and engineering to foster effective automation.

- Initiate a program to define a systematic process for function allocation between humans and automation.

- During development, make the satisfaction of quantitative human performance requirements obligatory for human functions.

- Establish a robust process for operations and support manpower requirements determination during ACTD programs.

In order to learn quickly during the flight and operational tests of the near-term UAVs, immediately establish a program to carefully evaluate the flight operations of the Predator, Dark Star, and Global Hawk programs to assure maximum understanding of both ground crew station and air vehicle human factors and automation aspects.

Recommendation 5 - ***Establish UAV experimental capabilities to address crew-vehicle flight management concepts.*** Include:

- A multi-discipline staff (e.g., operations, human factors, cognitive sciences, systems engineering). Use the Air Force Armstrong Laboratory, universities, and industry.

- A reconfigurable crew station experimental facility for experimental investigation and rapid prototyping of UAV control station functions, displays, and controls.

- A testbed aircraft (F-16?) configured to explore the full range of control, from fully manned to fully autonomous, for combat air operations. Testing a full range of possible man-automation mixes will aid in optimizing UAV control.

Recommendation 6 - ***Expand work in critical enabling platform and propulsion technologies***. Work should include:

- High-altitude, fuel efficient engines

- Structural design methods for high reliability for a limited life

- Lightweight, low-cost composite structures manufacturing

- Mission flight executives for vehicle/flight control

- Engine and structure ATDs

- Integrated design approaches for UAVs

Recommendation 7 - ***Supplement avionics and mission systems technology base programs in areas critical to UAV operations.*** Though most of the mission systems technology appropriate to UAVs is relatively mature, some additional efforts and demonstrations are very important:

- Develop techniques and algorithms for higher orders of mission system autonomy.

- Place major emphasis on automatic target recognition (ATR) programs.

- Support subsystem and component miniaturization in high-payoff areas.

- Explore alternatives for low-cost, low-observable sensor apertures and windows.

- Investigate use of unattended ground sensors (UGS) in conjunction with manned and unmanned aircraft. UAVs provide ideal control and communications relay platforms for UGS use.

Recommendation 8 - ***Initiate a modular weapons and warhead program specifically oriented to the mission tasks most suited to UAVs.***

- Create a family of UAV weapons.
  - Transition LOCAAS to EMD/Production (100 lb)
  - Demonstrate kinetic energy penetrator with various warheads (75-100 lb)
  - Perform concept definition of a hypervelocity missile for BPI and air-to-air
  - Short- and medium-range air-to-air missiles

- Develop technologies for low-cost, lightweight, highly effective warheads.
  - Establish cooperative warhead programs with NSWC (Indianhead)
  - Demonstrate explosively driven HPM warhead

- Develop concepts to enhance resistance to GPS jamming.

Recommendation 9 - ***Initiate a broad program to address opportunities for dramatically reducing operations and support costs for UAVs.***

- Develop long-term storage (dormant reliability) techniques suitable for UAVs.

- Formulate design methods for highly reliable, short-life UAV systems and subsystems.

- Emphasize modular, palletized construction for subsystems commonality, wide application, and mission flexibility.

- Develop maintenance concepts for the unique nature of UAVs.

- In conjunction with the above, investigate traditional and nontraditional basing concepts, unit sizes, deployments, and organizations.

- Develop a comprehensive strategy to exploit the potential for dramatic life-cycle cost savings.

Recommendation 10 - ***Promote C^3I architectures, compatible with the TBMCS, that consider UAVs in the context of the overall Joint Forces structure.*** Include:

- Mission planning

- Dissemination, data fusion

- Mission payload control

- Complementary activities with other weapons systems

- Airspace deconfliction

- Communications management

Recommendation 11 - ***Develop systems, concepts, and processes for UAV airspace management and deconfliction.*** Include:

- Airspace scenario and mission planning for UAVs.

- Dynamic mission replanning for UAVs similar and complementary to that used by manned aircraft, to assure optimal mission profiles against time-sensitive targets and threats.

- Integration into the FAA and theater air traffic control environment.

- Collision avoidance equipment and schemes (TCAS, IFF, etc.).

- Consideration of multinational operation in the international airspace environment.