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Report of the Panel  
ON  
REMOTELY PILOTED VEHICLES

15 Jul 1971

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Date: 13 JAN 2016

1971 SUMMER STUDY

Defense Science Board  
Colorado Springs, Colorado

Office of the Director of Defense Research and Engineering

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Report of the Panel

on

REMOTELY PILOTED VEHICLES

19-31 July 1971

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1971 Summer Study  
Defense Science Board  
Colorado Springs, Colorado

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DEFENSE SCIENCE BOARD TASK FORCE  
ON  
REMOTELY PILOTED VEHICLES

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I. Introduction

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The Problem

Weapon system cost and losses to enemy counteraction are of increasing concern, with respect to manned aircraft. In some environments already experienced and forecast for the future, the need arises for alternative systems to complement the capability of manned aircraft, principally for the following reasons:

1. For some tasks manned aircraft may be too expensive to procure and operate, even without attrition from enemy action. (For example, reconnaissance beyond line of sight in support of ground patrols.)
2. Overflight by manned aircraft of enemy or neutral territory may be politically unacceptable because of treaties, rules of engagement, and risk of imprisonment for aircrews.
3. Increasing strength of enemy ground defenses may result in high attrition -- high enough to preclude sustained operation, to prevent achievement of the military objective, and/or excessive cost in human and material resources.

The third factor, is of special concern, because of the development and extensive deployment in many parts of the world of effective Soviet surface-to-air gun and missile defense weapons. Particularly in this context, substantial interest and activity on RPV's has been generated over the past year, prompting the Director of Defense Research and Engineering to establish the present Task Force on Remotely Piloted Vehicles.

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RPV Task Force and Summer Study

The DSB Task Force on Remotely Piloted Vehicles (RPV) has been chartered to assess whether RPV's offer a solution to those military problems which are increasingly difficult to solve by manned aircraft; and if so, to recommend steps that DDR&E can take to bring about significant RPV capabilities for the Military Services.\*

For the 1971 DSB Summer Study, the scope of the Task Forces's investigation was deliberately limited to encompass only those RPV tasks that contribute to the destruction of tactical targets in limited, non-nuclear warfare\*\*. The Military Services, especially USAF, have a substantial body of experience of operating unmanned reconnaissance missions in combat zones, which, in fact, constitutes a significant portion of the data base available for the present study. The Task Force intends to examine, at a later time what contributions advanced RPV-technology can make to other military missions not considered in the 1971 Summer Study.

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\* The Task Force Charter is shown in Annex 1 hereto.

\*\* Annex 2 gives the Terms of Reference for the DSB Summer Study on RPV's.

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Definition of an RPV System

The concept of remotely piloted vehicles (RPV's) is not new. The TARZON missile, developed during World War II, could be considered to fall within the definition, as could a number of B-17s and B-24s that were modified to perform special missions. These aircraft were taken off by a crew of two, who later bailed out, and were flown to target by remote control. Since the early RPV experimentation during World War II with but marginal technology, significant advances have been made in sensing devices, flight control systems, signal transmitting techniques, data processing, and displays. All of these elements contribute to the capability to remotely pilot an aircraft and perform a military mission.

In the context of present technology we can define an RPV as a vehicle (or "telecraft") which is controlled by one or more operators from a remote control center. The operator is cued by sensors on the vehicle. The information transmitted from the sensors to the remote operator and his instructions for control of the vehicle are on a real-time basis. Although he is not in the RPV, the remote pilot is "in the loop" by virtue of a two-way data link. He controls the vehicle through a set of instruments and by a visual display as if he were in the cockpit.

In military operations, the RPV system would be closely coupled with other manned or unmanned weapon systems, as illustrated in figure 1. Here a remotely piloted aircraft is used to designate with a remotely-

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pointed laser beam a specific mobile target for attack by an artillery-launched projectile which homes on the laser-illuminated target.\* Depending on the distance and terrain between the RPV and the control station, a relay may be needed to maintain two-way communication. The relay may be carried by an aircraft, a satellite, a balloon or mounted on a tower (as illustrated in figure 1).

### Approach

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Prior to the Summer Study, the Task Force examined a great variety of missions which are or might be suitable for remotely piloted vehicles, as shown in figure 2, as a basis for subsequent identification of military needs. The Task Force was briefed extensively on the considerable number of DOD programs that relate to some of the listed RPV missions, especially to classical reconnaissance and defense suppression.\*\* The Task Force also surveyed the state of the art of the major RPV component technologies, by means of briefings and reports published by DOD agencies and industrial contractors, as a basis for assessing feasibility and cost of potentially desirable RPV systems.\*\*\* Applying during the two weeks

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\* The laser terminally guided weapon could, of course, be launched from an airplane, a helicopter, another RPV, or a surface rocket launcher.

\*\* Briefing topics, and the respective cognizant agencies are summarized in Annex 3.

\*\*\* Annex 5 summarizes the state of the art of RPV component technologies.

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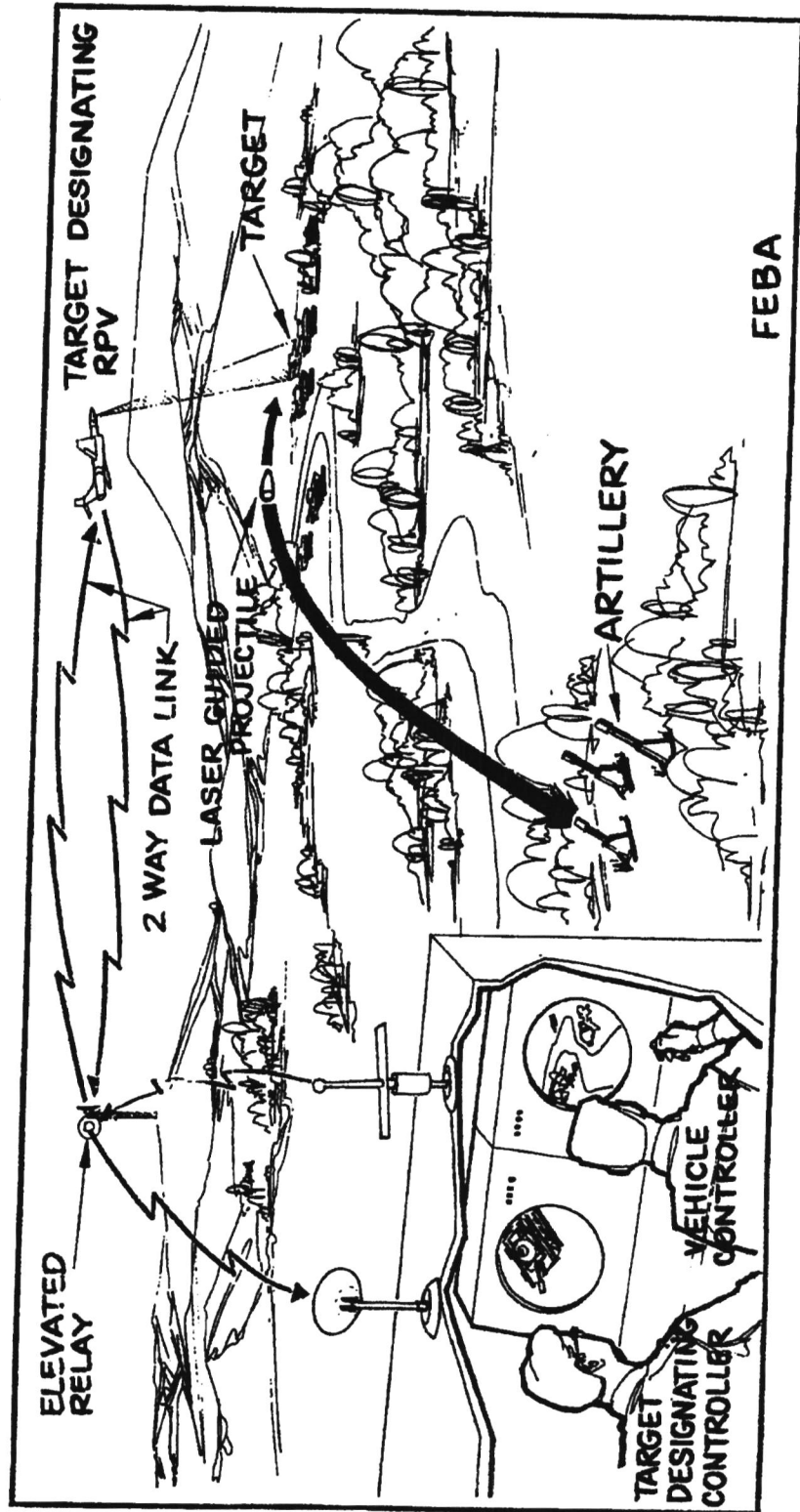


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# WHAT IS A REMOTELY PILOTED VEHICLE?

FIGURE 1



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FIGURE 2

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SOME MISSIONS POTENTIALLY SUITABLE FOR RPV'S

Reconnaissance/Surveillance

Classical photo reconnaissance  
Elint/Sigint  
Battlefield surveillance  
Location of enemy transmitters  
Eye Ball extension for infantry patrols

Target Destruction or Assistance Thereto

Recce-strike of moving or fleeting targets  
Destruction of prime tactical target (fixed or moving)  
Defense suppression: roll back of SAM sites, airfield defenses, and  
army forward air defense  
Destruction of enemy ships at stand-off range  
Target locator for indirect fire weapons and artillery spotting  
Target designation for terminally guided missiles or manned aircraft-  
launched weapons  
Electronic countermeasures: jammers, chaff dispensors, decoys

Air to Air Combat

RPV dog fighter for air defense or escort of strike force  
Fully-maneuvering target for air-combat pilot training

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Summer Study its collective judgement and experience to this mission and technology data base, the Task Force arrived at the Conclusions and Recommendations given in the next two sections of this report. The subsequent five sections (IV through VIII) describe each of the actions recommended.

Additional material is contained in the several Annexes that are keyed in the text by footnotes.

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## II. Conclusions

The major conclusions of the Summer Study on Remotely Piloted Vehicles are as follows:

1. The principal advantages of RPV's are that they:
  - o Keep man in the loop without exposure to injury or capture
  - o Remove physiological restraints on vehicle size and performance; this exerts great leverage on reducing the vulnerability and cost of the airframe and increasing its maneuverability (if necessary).
2. RPV's complement manned aircraft and are more cost-effective in the "high attrition" part of the mission spectrum. \*
3. Past program experience shows that RPV's:
  - o Can be launched, controlled, and recovered
  - o Can acquire, identify, and destroy targets
  - o Were generally survivable in Vietnam.
4. Current RPV activities exploit existing subsystems that are far from optimum, principally:
  - o Vehicles that were designed for use as target drones or high altitude platforms.
  - o Sensors, developed for high speed aircraft, in many cases more sophisticated and expensive than is appropriate for RPV's.
  - o Weapons, stockpiled in past wars for manned aircraft use.

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\* "High attrition" denotes situations where sustained (tactical) operations with manned aircraft are impractical or unfeasible, as discussed in Section VI.

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5. New tactical RPV systems are needed for:
  - o Real-time battlefield surveillance, target location, and laser designation of targets for terminally guided weapons.
  - o Destruction of armed vehicles and enemy mobile air defenses.
  - o Destruction of strongly defended interdiction and counter-air targets.
  
6. A jamming-resistant data link is needed for future RPV's under some combat conditions. Its development can be based on known spread-spectrum techniques.

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