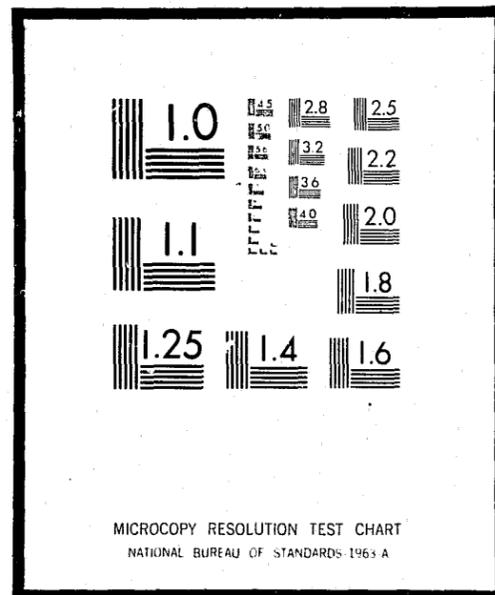


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EQUIPMENT SYSTEMS IMPROVEMENT PROGRAM -- DEVELOPMENT

EVALUATION OF AERIAL VEHICLES FOR LAW ENFORCEMENT APPLICATION

EXECUTIVE SUMMARY

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JUNE 1973

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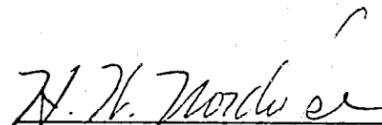
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FOR LAW ENFORCEMENT APPLICATIONS

EXECUTIVE SUMMARY

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CHAPTER I. INTRODUCTION

In the last few years the use of aircraft in police operations has increased significantly. Helicopters have been employed in patrol, surveillance, search and rescue, as command posts, and in controlling traffic, to mention but a few applications. Probably the most dramatic impact that aerial capability has had on law enforcement is shortened response time (Ref. 1-2a of basic report*).

With the acquisition of aerial vehicles, police departments were introduced to an entirely new level of surveillance capability. They were also introduced to an entirely new level of vehicle costs--both initial and operational. Since today's law enforcement aerial fleet is composed primarily of helicopters, the high costs are associated with the use of such aircraft.

The choice of most law enforcement aircraft is made on the local level. Regardless of wide variations in local geographic, climatic, political and demographic factors, the total fleet nation-wide is composed almost exclusively of helicopters. This situation will probably continue as long as local police agencies feel less subject to criticism if they follow suit and buy helicopters. On the other hand, undertaking an evaluation program of alternative vehicles could be expensive, time consuming, and require personnel qualifications not often available at the local level. Nevertheless, other

*Evaluation of Aerial Vehicles for Law Enforcement Application, Aerospace Report No. TOR-0073(3657-01)-1 (June 1973).

aircraft types are offered periodically to police agencies and these often have promising features which should be evaluated.

This study provides a response to the question of whether more cost-effective aerial capability can be attained and maintained with aerial vehicles other than the helicopter and provides a tool for future evaluation of aerial vehicles for law enforcement applications. This report is a primer to acquaint the police agencies with many of the practicalities of aircraft evaluation and purchasing, and at the same time to introduce aircraft manufacturers to the special requirements of the police agencies. This improved communication between the two groups should result in increased cost effectiveness of the country's law enforcement fleet. Check lists are provided which are useful for formulating questions for procurement and for cost accounting purposes. The report also eliminates the need for the Law Enforcement Assistance Administration (LEAA) or local law enforcement agencies to perform state-of-the-art investigations of aircraft capabilities and cost factors.

CHAPTER II. BACKGROUND

One of the vehicles frequently offered as an alternative to the helicopter is the autogiro. Apparently this suggestion was made often enough to LEAA to result in authorization of this study which, when initiated, was directed exclusively towards the evaluation of autogiros. Subsequently, blimps and fixed wing aircraft were added requiring the study approach to change from a detailed investigation of specific aircraft to a parametric evaluation of generalized types. This took the form of a novel performance analysis method devised to ensure objective treatment of all types of aircraft regardless of their state of development or off-the-shelf availability. The computer model and program developed for this study is original in defining an approach and providing the tools for future evaluations regardless of the particular aircraft type or mission. Using this computer model, LEAA (and/or Aerospace) is now in a position to provide an aircraft performance evaluation service to local law enforcement agencies during periods when they are involved in aircraft procurement.

An extensive analysis of cost statistics was undertaken to determine the correlation between aircraft type, function, mission capability, and cost, particularly as they relate in a law enforcement vehicle. A cost model was developed which provides a rational basis for cost estimation based on desired function as defined by the police aircraft user. The simple procedures presented in Chapter VI of the basic report permits local law enforcement agencies to generate preliminary cost estimates without reference to other documentation or extensive state-of-the-art surveys.

The present price structure of helicopters, which are two to three times as costly as fixed wing aircraft, is projected to continue into the foreseeable future so that vehicle cost savings can be attained only by sacrificing certain of the helicopter's advantages, such as hovering. While a preliminary police mission analysis by the Mitre Corporation indicated little need for the helicopter's hovering capability (Ref. 1-11 in the basic report), the primary factor militating against the wider acceptance of fixed wing aircraft for police surveillance work is the 1000-foot minimum altitude restriction for fixed wing aircraft flying over a populated area set by the Federal Aviation Administration (FAA).

Of much greater importance to the overall picture is the fact that personnel costs are much more significant than vehicle costs. As far as overall system costs are concerned, a significant reduction in personnel would justify a considerable premium in vehicle and equipment costs if such a tradeoff were possible. This realization immediately suggests the consideration of unmanned systems, but also serves to illuminate the fact that overall system measures of effectiveness are not available against which to test the cost effectiveness of law enforcement activities.

The end result is that the study disclosed several areas of promising potential quite different from the original expectations. Specifically, the performance analysis work, in the section of the program dealing with Lighter-than-Air Craft, identified a family of "hybrid" aircraft as candidates for police aerial vehicles. This was based on their endurance, a low-speed capability competitive with helicopters, and top-speed capabilities

well above those of pure Lighter-than-Air Craft (dirigibles and blimps) and adequate to meet police pursuit requirements.

The Hybrids, or Blimp Variants, are aircraft which attain part of their lift by the use of a buoyant gas (helium) and therefore can fly much more slowly than pure airplanes. Being partially buoyant they share with blimps the characteristics of safe "crashes" and are thus ideal for use at low altitudes over populated regions. In fact, this type of aircraft would eliminate so much of the danger of crashes to people on the ground that serious consideration can be given to low-flying, remotely controlled unmanned vehicles.

The use of such remotely piloted vehicles for police surveillance work would eliminate a large percentage of the personnel costs involved in manned vehicle operation and is made feasible by the many recent advancements in airborne electronics, optics, television, and data transmission equipment. Of course, only a portion of the police aerial vehicle mission spectrum can be met by such purely surveillance types and the optimum system will most likely comprise a variety of types including rotary wing, fixed wing, and hybrid aircraft, both manned and unmanned. The composition of an "optimum" fleet however will depend upon applying measures of effectiveness much more definitive (i. e., quantitatively defined) than are now available.

CHAPTER III. CONCLUSIONS

The following list represents the major conclusions derived from the study:

1. The rate at which aircraft (primarily helicopters) are being added to the country's law enforcement fleet is higher than ever before; however, the total number of aircraft added per year is still small. For this reason there is no immediate risk that a non-optimum choice of aircraft type will result in a significant economic drain. In fact, the risk, if any, can be eliminated by purchase of popular off-the-shelf aerial vehicles with ready resale market.
The risk becomes progressively greater as the fleet expands, more specialized mission capability is added to the vehicle and its equipment, and crews become trained in the use of this equipment. It is therefore important that a solid basis for mission planning and equipment purchasing be established now during the low-risk period in order to have the maximum effectiveness in reducing future risk.
2. The major cost of maintaining an aerial capability is not associated with the vehicle itself but with the cost of personnel to man the system.
3. Vehicle costs, both first and operational, are substantial, and reductions are well worth pursuing but so are actions which

reduce the cost of personnel. It is quite possible that overall cost savings may result from the introduction of more sophisticated (and expensive) hardware, rather than by the introduction of more austere equipment, if this sophisticated equipment will allow a significant reduction in personnel costs.

4. A large number of police missions can be accomplished by aerial vehicles of less complexity and cost than the helicopter. For larger fleets in particular, it would appear that a mix between helicopters and lower cost fixed wing airplanes would represent a more cost-effective operation than a fleet composed exclusively of helicopters. The fixed wing types would be much more attractive if they were allowed to fly lower than the 1000-foot minimum specified by the FAA.
5. Other types of aircraft, autogiros, blimps, hybrids, flying platforms, etc., all have particular advantages which would make them useful for police work if they were available. However, without more extensive cost effectiveness studies LEAA would not be justified in initiating expensive research and development work associated with the basic vehicle (as opposed to specialized police equipment) as long as there is an adequate selection of off-the-shelf helicopters and fixed wing aircraft.
6. Since personnel represent such a large portion of the costs of maintaining an aerial operation, systems which can operate with a small staff are obviously attractive. Remotely operated vehicles

offer a potential for cost savings by reduction of personnel requirements. Effectiveness and particularly safety considerations require further study before the extent of such savings can be assessed. A miniaturized version of the hybrid-type aircraft related to the blimp, as defined by this study, offers the promise of solving the safety problem.

7. Without overall system measures of effectiveness, data generated on aerial vehicles (or any other topic) cannot be related on a rational basis to other elements of the total system. Therefore, the choice of one vehicle over another still involves a number of nonquantified factors, and as long as this situation exists it will be difficult to avoid a certain dependence on subjective inputs.

CHAPTER IV. RECOMMENDATIONS

Based on the findings of the study, the following recommendations are offered:

1. The choice of aerial vehicles for law enforcement applications should be made on the basis of careful, deliberate field evaluation programs established under a consistent set of pertinent, well-defined measures of effectiveness which include results as well as costs. Representative candidates of all aircraft types should be evaluated as they become available. For example:
 - a. Although no autogiro of a suitable size is in production, at least one or two certified machines of a design and size suitable for field evaluation could be obtained by lease if not by purchase.
 - b. Several new fixed wing airplane designs also offer features of particular pertinence to police applications because of their performance and/or configuration. These, too, bear consideration for evaluation providing that they are certified by their builders or that such certification would not be too costly for LEAA to consider.
2. LEAA should establish a centralized aviation bureau, the purpose of which would be to collect, organize, and analyze data obtained from all the law enforcement agencies employing aircraft. The goal of this operation would be to establish accurate statistical

records regarding costs of aerial operations and to provide a centralized clearing house of information regarding aircraft and equipment recommendations, deficiencies, corrective actions and optimum usage techniques. Such a central information bureau would prove invaluable in increasing the effectiveness of individual agencies because they would benefit from experience by all other groups. It would also be very useful to agencies which are instituting their first aerial operations by helping them start with a realistic operational and financial plan.

3. There would appear to be a reasonable basis for LEAA to approach the FAA for a special dispensation to fly fixed wing aircraft at lower altitudes. This would be based on the special design of such aircraft which would provide multi-engine reliability or the alternative capability of gliding long distances to landing areas outside of congested areas. The present 1000-foot rule applies to all fixed wing aircraft equally, whether they have a gliding ratio of 3:1 or 30:1. It would seem that this rule should take into account such variations between aircraft as it does for the differences between fixed wing and rotary wing aircraft. If such permission were granted, a whole new array of possibilities would be open for consideration to law enforcement agencies.
4. Several preliminary design studies of specialized police aerial vehicles should be supported by LEAA to generate standards against which to evaluate new proposed vehicles. This present

report has covered the basic types, i. e., Airplanes, Helicopters, Autogiros, Lighter-than-Air Craft (LTA's and Hybrids), and the critical parameters of these types have been established and extensively examined. This work has indicated that the following design studies would be fruitful.

- a. Airplane designs providing optimum crew accommodations and visibility and with special features allowing operation below the present 1000-foot FAA minimum:
 - (1) Twin engine designs.
 - (2) High lift/drag designs.
 - (3) Emergency zero-speed landing devices.
- b. Lower first cost helicopters.
 - (1) New non-turbine designs.
 - (a) Reciprocating engines.
 - (b) Wankel engines.
 - (2) Simplified designs.
 - (a) Alternatives to gear transmission (belts, drives, pressure jet propulsion, etc.).
 - (b) Emergency vertical takeoff systems for autogiros.
- c. Lower operating cost helicopters.
 - (1) Compound helicopters to reduce wear and increase life of gearboxes and hubs.

- (2) Twin reciprocating engines--cruise on one engine to extend life between overhauls; also greater safety.
- d. Reduce personnel requirements.
 - (1) Automated equipment.
 - (2) Remotely piloted vehicles, especially of the miniature blimp-related (hybrid) types.
 - e. Advanced mission studies.
Application for unusual vehicles such as flying platforms and hybrids, within realistic technical limitations foreseen for these vehicles at this time.

END